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4	6	**14312** (BDX-613-2038(Rev.)) **RTV tooling evaluation. Final Report.** Belarde, E. (Bendix Corp., Kansas City, MO (USA)). Dec 1978. Contract EY-76-C-04-0613. 17p. Dep. NTIS, PC A02/MF A01.
4	11	**29885** (NUREG/CP-0002) **Larval exclusion systems for power plant cooling water intakes.** Sharma, R. K.; Palmer, J. B. (eds.). (Argonne National Lab., IL (USA)). Aug 1978. Contract W-31-109-ENG-38. 243p. (ANL/ES–66; CONF-780257–). Dep. NTIS, PC A11/MF A01.
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4	12	**33305** (NUREG/CR-0786) **FRAP-S3: a computer code for steady state analysis of oxide fuel rods. Model assessment report.** Coleman, D. R.; Laats, E. T.; Scofield, N. R. (Idaho National Engineering Lab., Idaho Falls (USA)). Apr 1979. Contract EY-76-C-07-1570. 100p. (TREE–1352). Dep. NTIS, PC A05/MF A01.
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4	16	**42334** (NVO-0680-1) **Pacific Transmission Supply Company, Sand Ridge Ii Mesaverde massive hydraulic fracture project, Unitah County, Utah. Final report.** Beardsley, D. E.; Allen, B. W. (Pacific Transmission Supply Co., Casper, WY (USA); Almac Operating Co., Casper, WY (USA)). Sep 1978. Contract EY-76-C-08-0680. 180p. Dep. NTIS, PC A09/MF A01.
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Volume 4, Number 22, November 30, 1979

ENERGY RESEARCH ABSTRACTS

COAL AND COAL PRODUCTS

REFER ALSO TO CITATION(S) 53131, 53308

52419 (BNL—51002, pp 1-10) **Overview from fossil energy.** Abrahams, J.H. (Dept. of Energy, Washington, DC). Mar 1979.

From Symposium on assessing the industrial hygiene monitoring needs for the coal conversion and oil shale industries; Upton, NY, USA (5 Nov 1978).

An overview of US DOE's research program in fossil fuels gives budgets for US coal research from 1964 to 1979. Coal gasification and liquefaction are discussed with emphasis on health hazards, industrial medicine and environmental effects and what US DOE is doing in these latter areas. (LTN)

52420 (NE—1977-24) **Coal in Sweden: background.** (Naemnden foer Energiproduktionsforskning, Stockholm (Sweden)). May 1978. 287p. (In Swedish). U 13/MF A01.

This report contains reviews of coal production, trade, transport, handling, combustion and conversion. Environmental, safety and economic aspects of these activities are also treated. The material served as a collection of background facts for the study Coal in Sweden, Main report (NE—1977:24). It contains a list of Swedish research projects financed by the National Swedish Board for Energy Source Development as of June 1978.

52421 (ORNL—5487) **Fossil Energy Program. Quarterly progress report for the period ending September 30, 1978.** McNeese, L.E. (Oak Ridge National Lab., TN (USA)). Jan 1979. Contract W-7405-ENG-26. 278p. P 11/MF A01.

This quarterly report covers the progress made during the period July 1 through September 30 for the Oak Ridge National Laboratory research and development projects that are carried out in support of the increased utilization of coal and other fossil fuel alternatives to oil and gas as sources of clean energy. These projects are supported by the DOE Divisions of Coal Conversion; Power Systems; Oil, Gas, and In Situ Technology; Program Control and Support; Basic Energy Sciences; and Biomedical and Environmental Research, and by the EPA Office of Research and Development through interagency agreement with the DOE.

52422 (ORNL/TM—6682) **Fossil Energy Program. Progress report for November 1978.** McNeese, L.E. (Oak Ridge National Lab., TN (USA)). Jan 1979. Contract W-7405-ENG-26. 65p. P 04/MF A01.

This report - the fifty second of a series - is a compendium of monthly progress reports for the ORNL research and development programs that are in support of the increased utilization of coal and other fossil fuel alternatives to oil and gas as sources of clean energy. The projects reported this month include those for coal conversion progress development, material engineering, alkali metal vapor topping cycles, a coal equipment test program, an AFB coal combustor for cogeneration (CCC), engineering and support studies, process and program assistance, environmental assessment studies, magnetic beneficiation, and AFBC demonstration plant.

PROCESSING

CARBONIZATION

52423 **Coal hydrogenation char as blending agents for coke production.** Wood, R.E.; Bodily, D.M. (Univ. of Utah, Salt Lake City). Contracts EE-77-5-03-1484;E(49-18)-2006. *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **24**: No. 2, 364-370(1979). (CONF-790415—P3).

From 177. national meeting of the American Chemical Society; Honolulu, HI, USA (1 Apr 1979).

A laboratory scale examination of the possibility of using coal liquefaction char residues as a blending material with marginally coking coals to enhance the desired properties of the resulting coke was studied. Properties of resultant coker tested were Free-Swelling Index, strength, CO_2 burnoff rate and combustion temperature. Some coal liquefaction chars showed extreme swelling in the standard volatile matter test. It was apparent that some coal liquefaction chars did possess physical and chemical characteristics that would be desirable in coal blends used for the production of metallurgical grade coke. These were fluidity, strength and combustion temperature. The CO_2 burnoff rate was not improved by the addition of the chars used in this study. At 80 and 90%, the low conversion char had no advantage, but the high conversion char was at least equal to the standard additive for combustion temperatures. If FSI were the only criteria required for blending material, then R-71 (conversion of 75% of the coal matter to liquids and gases) would make a good substitute for Coal Basin coal in the Geneva coke starting material. 3 figures, 6 tables.

DESULFURIZATION AND PURIFICATION

REFER ALSO TO CITATION(S) 52479, 52486, 52508, 52514, 53138, 53143

52424 (CONF-790803—37) **Particle size distribution in coal-derived liquids as a function of degree of coal conversion.** Gilliam, T.M.; Brand, J.I.; Rodgers, B.R. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 4p. P 02/MF A01.

From 14. intersociety energy conversion conference; Boston, MA, USA (5 Aug 1979).

Particle size distribution data on slurries of reacted coal-anthracene oil mixtures indicate that the fraction of particles with diameters $<10\ \mu$ increases steadily to 20% at a conversion of 85%; at higher conversions, it increases very rapidly to 60%. Filtration of the slurries suggests a relationship between overall filtration rate and conversion.

52425 (COO—4196-3, pp IX.1-IX.16) **Alternate acid gas removal system study.** Schatz, D.A. (Carnegie-Mellon Univ., Pittsburgh, PA). Sep 1978.

In Energy conservation in coal conversion. Final report, September 15, 1977—September 1, 1978. Selected case studies and conservation methodologies.

In the Ralph M. Parsons Oil/Gas Conceptual Design, the acid gas removal system uses MEA (monoethanolamine) to strip the dissolver gas of H_2S and CO_2. Since the MEA system has a high steam consumption, 190,300 lbm/hr, we examined the feasibility of using a DEA (diethanolamine) which uses less steam. Since the DEA system meets the required plant specifications of (<5 ppM CO_2, $<.25$ grain/ccf H_2S) and saves a significant amount of energy as well as chemicals, it should be used. There exists an additional area for energy savings in the DEA system. A step-down turbine installed between the contactor and the surge tank could supply up to 50% of the shaft power required to drive the high pressure amine pumps. This is 1200 Hp or $177,000 savings per year for electricity at .025 $/KW hr.

52426 (EPA—600/7-77-130) **Coal cleaning: an option for increased coal utilization.** Balzhiser, R.E.; Deurbrauck, A.W.; Gage, S.J. (Environmental Protection Agency, Washington, DC (USA). Office of Research and Development; Battelle Columbus Labs., OH (USA)). Aug 1978. 154p. (CONF-7705167—). NTIS PCA 08/MF A01.

From Conference on coal cleaning - an option for increased coal utilization; Arlington, VA, USA (24 May 1977).

The coal cleaning conference was held in Arlington, Virginia, May 24—25, 1977. The Conference was co-sponsored by the US Environmental Protection Agency and Battelle's Columbus Laboratories. The conference focused on the present status and future possibilities of coal cleaning technology, with emphasis on regulatory, institutional, and economic factors. Papers describe application of alternatives vs. coal cleaning. Seven papers from the proceedings have been entered individually into EDB and ERA. (LTN)

52427 (EPA—600/7-77-130, pp 65-84) **Coal cleaning applications for SO_2 emission control.** Kilgroe, J.D. (US Environmental Protection Agency, Research Triangle Park, NC); Raines, G.E.; Smithson, G.R. Jr. Aug 1978.

From Conference on coal cleaning - an option for increased coal utilization; Arlington, VA, USA (24 May 1977).

Physical coal cleaning can be used to meet a variety of state and Federal SO_2 emission regulations, singly or in combination with flue gas desulfurization. There is an increasing awareness by the coal and utility industries of coal cleaning as a method of SO_2 control. The following advantages lend attractiveness to the technique: It is possible in the near term; it is relatively low cost; it is applicable to both small and large boilers; and it may be used for compliance with many state standards. However, the following disadvantages must be considered on a case-by-case basis: It is not applicable for all coals and all standards; coal sulfur variability, in both content and form, leads to poor product quality control; the locations and quantities of cleanable reserves are uncertain; and cost, regulatory, and institutional uncertainties prevent definitive plans. Taking these facts into consideration, it may be concluded that: The technology is commercially available; it is the lowest cost control method for some coals; it has a large potential for small boilers, particularly those less than 250 million Btu/hour which do not have to meet new source performance standards; it is not, however, universally applicable; and cost, regulatory, and institutional uncertainties inhibit its rate of implementation.

52428 (EPA—600/7-77-130, pp 85-108) **Engineering/economic analyses of coal preparation with SO_2 cleanup processes for keeping higher sulfur coals in the energy market.** Hoffmann, L. (Hoffman-Muntner Corp., Silver Spring, MD); Deurbrouck, A.W. Aug 1978.

From Conference on coal cleaning - an option for increased coal utilization; Arlington, VA, USA (24 May 1977).

Currently and potentially available methods for controlling sulfur oxide emissions from coal-fired stationary combustion sources fall into the following categories: The use of low sulfur coal either naturally occurring or physically cleaned; removal of sulfur oxides from the combustion flue gas; chemical treatment to extract sulfur from coal; and conversion of coal to a clean fuel by such processes as gasification and liquefaction. For amenable coals physical removal of pyritic sulfur (principally FeS_2) is the lowest cost method and has the most developed technology. Even so, the potential total sulfur reduction is limited since organic sulfur cannot be removed by this process. Another approach to controlling SO_2 emissions could be the combined use of physical cleaning followed by stack gas scrubbing. The potential benefits derived from combined physical cleaning and flue-gas desulfurization include: The ability to utilize high-sulfur coal with minimal to moderate physical cleaning; the availability of a more uniform coal; lower effective transportation costs; reduced maintenance costs; and lower coal grinding and ash disposal costs. Available data indicate that many coals can be beneficiated to remove ash and sulfur at an attractive net cost. Case studies indicate that for many potential situations the economic advantage of a combined approach is quite significant. Key elements in this economic advantage relate to: The availability of coals capable of significant reductions in ash and sulfur at reasonable weight yields, and a beneficiated coal sulfur level compatible with significantly less than full scale scrubbing requirements. The range of variables is such that each coal source/user combination must be individually assessed. (LTN)

52429 (EPA—600/7-77-130, pp 109-118) **EPA region IV TVA study.** Isaacs, G.A. (PEDCo Environmental, Inc., Cincinnati, OH). Aug 1978.

From Conference on coal cleaning - an option for increased coal utilization; Arlington, VA, USA (24 May 1977).

Although coal cleaning is not a new technology, the concept of using a coal cleaning plant to remove pyritic sulfur from coal in order to permit a boiler to meet applicable SO_2 emission regulations is relatively new. The potential implementation of this concept is described briefly in this paper, and examples are presented which show that certain coals may be amenable to cleaning within the SO_2 constraints of a particular utility system. Similar potential applications may exist for other utility systems faced with the need to comply with SO_2 emission restrictions. In 1975, Region IV of the US Environmental Protection Agency contracted with PEDCo Environmental, Inc. to investigate the washability potential of several TVA contract coals and to determine a feasible overall strategy shereby TVA might meet appropriate SO_2 emission restrictions. Data generated in that study are presented to show that some coals can be cleaned and used to meet SO_2 regulations. The examples cited do not necessarily reflect the best use of these coals within the TVA system and are presented for illustrative purposes only. The best use of these coals would have to be determined by TVA in conjunction with the total TVA coal supply and the firing requirements at all the plants. Although the developed strategy included the use of flue-gas desulfurization systems, this paper describes only the coal cleaning and coal redistribution aspects of the strategy. (LTN)

52430 (EPA—600/7-77-130, pp 119-129) **Homer City experience.** McConnell, J.F. (General Public Utilities, Parsippany, NJ). Aug 1978.

From Conference on coal cleaning - an option for increased coal utilization; Arlington, VA, USA (24 May 1977).

The local mines here cannot produce coal to consistently meet the equivalent of 4.0 lb $SO_2/10^6$ Btu. Therefore, the Homer City owners were compelled to remove sulfur. A project was initiated in 1973 to design and build a coal washing plant. Because of the vaue of Btu's, this design provided for heavy medium washing at high gravity (1.8) in conjunction with bypassed coal to minimize refuse losses. It is apparent from the body of washability data related to Homer City coal reserves that a unique and precedent setting washing plant operating at low specific gravity using dense medium cyclones on fine sizes down to 150 microns could in theory produce a compliance coal with the following fuel specifications: 1500 Btu/lb; 0.9 percent sulfur, and 2.5 to 3.5 percent ash. A great deal of engineering effort went into developing a suitable flow sheet. The cleaning plant at Homer City attempts to maximize the release of mineral matter through crushing or comminution. Typical Homer City coals are high in pyritic sulfur and low in organic sulfur. Therefore substantial reduction of sulfur is possible. There are both benefits and penalties from crushing: Fineness releases pyrite and mineral matter; but increases the difficulty and cost of washing procedures. (LTN)

52431 (FE—2028-11) **Kinetics and mechanism of desulfurization and denitrogenation of coal-derived liquids. Ninth quarterly report, June 21, 1977—September 20, 1977.** Gates, B.C.; Katzer, J.R.; Olson, J.H.; Kwart, H.; Stiles, A.B. (Delaware Univ., Newark (USA). Dept. of Chemical Engineering; Delaware Univ., Newark (USA). Dept. of Chemistry). 1 May 1978. Contract EX-76-C-01-2028. 79p. P 05/MF A01.

Flow reactor studies of HDS of dibenzothiophene at about 300°C and 100 atm have shown a new dependence of catalyst activity on H_2S concentration at low values. We infer that the catalyst undergoes structural changes during reaction, sometimes becoming sulfur deficient and relatively inactive. It is evidently necessary to maintain the catalyst in a properly sulfided state during reactor startup and operation by avoiding its contacting too little H_2S. The relative activities of Ni—Mo/Al_2O_3, CO—Mo/Al_2O_3, and Ni—W/Al_2O_3 catalysts for HDN of acridine have been determined, showing that Ni—Mo/Al_2O_3 is the most active. The results are interpreted inthe context of the acridine reaction network, in which both the hydrogenation and hydrogenolysis (cracking) reactions are kinetically important.

52432 (FE—2034-15) **Catalytic hydrogenation of coal-derived liquids. Interim report, March 1979-May 1979.** Berg, L.; McCandless, F.P. (Montana State Univ., Bozeman (USA)). Jun 1979. Contract EX-76-C-01-2034. 60p. P 04/MF A01.

The concept of fabricating catalysts specifically designed to hydrodenitrogenate solvent-refined coal has been started. Using catalyst bases of specific surface area, pore volume and pore diameter and impregnating them with tungsten, nickel, cobalt and/or molybdenum has yielded denitrogenation of SRC from 1.17% nitrogen to 0.2% nitrogen, desulfurization from 0.73% sulfur to 0.2% sulfur, and this at 390°C and only 1050 psig. The catalysts appear to be a cross between hydrotreating and hydrocracking catalysts and require a burn-off and resulfiding after about six hours of operation. They appear to offer the possibility of an economically attractive process for converting solvent refined coal into a feedstock for a conventional petroleum refinery.

52433 (LBL—8576) **Desulfurization of coal model compounds and coal liquids.** Wrathall, J.A.; Peterson, E.E. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1979. Contract W-7405-ENG-48. 101p. P 06/MF A01.

Thesis.

Most US coals contain sulfur concentrations that prevent their being burned without some form of sulfur removal. Current coal-cleaning technology can only remove the fairly reactive pyritic (inorganic) and aliphatic (organic) sulfur. A process which removes the more refractory hetero-aromatic sulfur could substantially increase the amount of coal reserves amenable to chemical cleaning. Sodium metal dispersions convert refractor model compounds into lig.uter desulfurized products and non-volatile sulfur-rich char. When treated with sodium, coal-derived solids show substantial desulfurization. The same treatment applied to coal-derived liquids, when combined with vacuum distillation of the reaction product, yields a

desulfurized light distillate, an increase in absolute amount of distillate, and retention of sulfur in the vacuum residue. The presence of sodium in the residue allows fixation of the residual sulfur as Na_2SO_4 upon combustion, eliminating production of SO_2 in the flue gas. Intimate contacting of sodium salts with high sulfur coal also fixes 97 to 99% of the sulfur as Na_2SO_4 upon combustion. This technique takes advantage of the high energy available for carbon-sulfur bond cleavage during combustion and the reaction of SO_2 to form Na_2SO_4 to provide an inexpensive method for complete coal desulfurization.

52434 (PNL—2841(Pt.1)(Pt.2)) **Process for cleaning and removal of sulfur compounds from hot low-Btu fuel gas. Part I: process development unit design and construction. Part II: pilot-plant experience.** Moore, R.H.; Stegen, G.E.; Mitchell, D.H.; Ham, D.G. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1979. Contract EY-76-C-06-1830. 317p. P 14/MF A01.

Parts 1 and 2 bound together have been indexed separately into EDB and ERA. (LTN)

52435 (PNL—2841(Pt.1)(Pt.2), pp I.1-I.A.5) **Process development unit design and construction.** Moore, R.H.; Stegen, G.E.; Mitchell, D.H.; Ham, D.G. Jun 1979.

In Process for cleaning and removal of sulfur compounds from hot low-Btu fuel gas. Part I: process development unit design and construction. Part II: pilot-plant experience.

Most current research in high-temperature gas cleaning is concerned with the use of various filters for particle removal. Pacific Northwest Laboratry (PNL), in a departure from this approach, has developed a unique process that uses liquid (molten) salt scrubbing both for particle agglomeration and removal and for extraction of sulfur compounds. A Process Development Unit (PDU) has been designed and constructed to demonstrate this process. The work reported herein concerns this design and construction phase of work. This PDU features unit operations never previously attempted at such extremes of temperature (700° to 730°C) and with molten salts as a working fluid. The process utilizes a venturi scrubber to circulate the molten salt, thereby eliminating failure-prone mechanical pumps. The venturi produces a fully entrained dispersion of the molten salt in the hot fuel gas. The dispersed salt droplets avidly extract sulfur compounds from the gas and adhere to and collect particles. The salt is de-entrained in a simple knockout drum. The gas then passes through two bubble-cap trays flowing countercurrent to regenerated salt. A packed-bed de-entrainer removes the residual salt from the gas. A portion of the salt is bled off for particle removal. The sulfur extraction capacity of the salt is then restored by reaction with steam + carbon dioxide to yield H_2S-rich gas (feed to a Claus sulfur converter). The regenerator is also a bubble-cap tray column. This PDU was operated in a series of short runs over a period of about one year, and successfully demonstrated salt regeneration and extraction of sulfur compounds to design levels. Particle removal and salt de-entrainment was highly efficient, and gas approaching the moving target for turbine quality gas was produced.

52436 (PNL—2841(Pt.1)(Pt.2), pp II.1-II.189) **Pilot-plant experience.** Moore, R.H.; Stegen, G.E.; Mitchell, D.H.; Ham, D.G. Jun 1979.

In Process for cleaning and removal of sulfur compounds from hot low-Btu fuel gas. Part I: process development unit design and construction. Part II: pilot-plant experience.

In an extension of research on high-temperature gas cleaning, Pacific Northwest Laboratory (PNL) has developed an unique process that uses molten salt scrubbing both for particle removal and for removal of sulfur compounds. A Process Development Unit (PDU) has been designed and constructed to demonstrate this process. The work reported here is concerned with the operating experience and data generated 16 runs conducted over a period of about a year. Reference should be made to Part I of this report for details of design and construction of the PDU. Efficient extraction of sulfur compounds (H_2S and COS) was demonstrated. Product gas ranged from 20 ppM to abut 250 ppM sulfur (total) with recovery dependent upon inlet gas sulfur content and salt sulfur loading. Extraction of sulfur compounds was found to follow thermodynamic theory and conformed to predictions based on earlier laboratory data. Data obtained was not sufficient, however, to confirm the theoretical models used in detailed design of the extraction (and regeneration) columns. This was due to difficulty in establishing and maintaining steady liquid flow rates. Particle removal by the packed-bed de-entrainer resulted in gas containing 140 mg/m^3. A polishing filter used in run C-13 reduced this to 37 mg/m^3. Serious operating problems results from the presence of iron, which occurred as an impurity in the salt. Iron was also introduced from corrosion of equipment upstream of the PDU and from corrosion of unalonized parts. The report concludes with a section covering simple modifications to the plant that would have substantially improved operability. Making these changes would have delayed completion of the program and would have required funding not then available.

HYDROGENATION

REFER ALSO TO CITATION(S) 52423, 52432, 52478, 52481

52437 **Possible hydride transfer in coal conversion processes.** Ross, D.S.; Blessing, J.E. (SRI International, Menlo Park, CA). Contract EF-76-01-2202. *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **24**: No. 2, 125-133(1979). (CONF-790415—P3).

From 177. national meeting of the American Chemical Society; Honolulu, HI, USA (1 Apr 1979).

The conversion of coal to liquid fuels is usually carried out in the presence of an H-donor solvent such as tetralin. The chemistry of the following process coal—coal in equilibrium to 2 coal . (1) coal . H donor → coal H (2) was discussed in this paper, including thermochemistry of Steps 1 and 2. Coal is converted under conditions where the common model compounds benzylphenyl ether and bibenzyl are mechanisms. Tetralin operates via hydride transfer, at least in its reduction of quinones. Operative mechanisms of coal conversion in both tetralin-like media and strongly basic systems may be the same, involving hydride donation by the H-donor solvent, followed by proton transfer. The major role of a reducing component in a coal conversion system was the reduction of quinones and perhaps other oxidants present in the coal rather than direct reduction of the coal. In the absence of an H-donor, then, oxidative crosslinking took place within the coal upon heating, yielding a product even less soluble in solvents such as pyridine than was the starting coal. On the other hand, in the presence of a reducing agent, either conventional H-donors such as tetralin or the hydride-donating systems, the quinones and other oxidants were reduced to unreactive materials, and the coal then proceeds to liquefy by means of a thermal process involving no addition of hydrogen. 7 tables.

52438 **Initial stage of coal hydrogenation in the presence of catalysts.** Yoshida, R.; Bodily, D.M. (Univ. of Utah, Salt Lake City). Contract E(49-18)-2006. *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **24**: No. 2, 371-378(1979). (CONF-790415—P3).

From 177. national meeting of the American Chemical Society; Honolulu, HI, USA (1 Apr 1979).

The initial stage of coal hydrogenation, where the reactivity was greatly affected by the chemical structure characteristics of the coal and the conversion per unit of hydrogen consumed was high, was studied. Several catalysts were studied and reactivity in an entrained-flow hydrogenation reactor and the chemical structure of the products were determined. Clear Creek, Utah, coal was hydrogenated; products were separated by stepwise extraction using hexane, toluene, and pyridine. Determination of C, H, and N for each product was carried out by a micro method using a Perkin—Elmer 240 CHN Analyzer. Results indicated that at least 20% of the coal used, converted noncatalytically into liquid and gas. $ZnCl_2$ was a very active catalyst in the initial stage of hydrogenation. It was concluded that a continuous distribution existed in the structural units of coal. The units taking part in the noncatalytic reaction up to about 20% conversion were characterized by higher H/C ratio, lower O, N, S/C ratio, higher content of aliphatic hydrogen ($H\alpha$ + H_θ), lower fa and 1-2 aromatic rings. In the catalytic reaction (greater than 20% conversion), the units taking part in the reaction were characterized by lower H/C ratio, higher content of Ha, higher fa and larger number of aromatic rings. 5 figures, 2 tables.

GASIFICATION

REFER ALSO TO CITATION(S) 52434, 52435, 52436, 52466, 52467, 52481, 52494, 52507, 52509, 52527, 53133, 53134, 53135, 53146

52439 (ANL/ES—77) **Application of availability engineering to coal gasification systems. A study of a Woodall/Duckham low-btu gasifier system for the Erie Mining Co.** Doctor, R.D.; Wang, P.Y.; Chopra, P.S. (Argonne National Lab., IL (USA)). Jul 1979. Contract W-31-109-ENG-38. 98p. P 05/MF A01.

The Erie Mining Company, Hoyt Lakes, Minnesota and the Department of Energy have studied construction of a demonstration coal gasification system utilizing Woodall/Duckham technology. The system would convert approximately 460 tons/day of either eastern or western coal to produce 45 MM SCF of fuel gas with a heating value of 176 Btu (HHV)/SCF as well as a coal tar and oil product that could be used as a back-up fuel. This report applies reliability, maintainability, and availability (RMA) engineering methods to this system. RMA methods make it possible to assess areas of system operation such as criticality of subsystems, unit availability, analysis of the net system availability, cost advantages of various configurations, lost production costs, and capital versus maintenance cost-trade-offs. This study indicates that the annual fuel production goal will be met if the contribution of the tar and oil product heating value is credited together with the fuel gas. This study was conducted for the US Department of Energy in support of the Office of Initial Operations and Materials, Division of Fossil Demonstration Plants.

52440 (CONF-7809162—, pp 28p, Paper 1) **Fossil fuel economics.** Knudsen, C.W.; Hedman, P.O. 1978.

From Workshop on coal liquefaction; Julich, F.R. Germany (18 Sep 1978).

A large number of fossil energy processes are now in various stages of research and development to produce substitute fuels for conventional oil and gas. Process design and cost estimation of new processes is an invaluable part of the development process to guide R and D to the most promising processes and to place experimental emphasis on the technical problems of greatest priority. Types of design and cost estimation are described as well as the uncertainties involved in the resulting estimates as they depend on data quality and the level of estimate detail. Project and process contingencies are given which have been found to be appropriate to account for the expected underestimation. Cost evaluations are described for coal gasification processes taken from the recent C.F. Braun and Co. report which compares new processes developments with commercial Lurgi coal gasification. Costs of approximately $5 per million Btu are indicated. Coal liquefaction costs for processes currently at the pilot plant stage of development are discussed. Liquid product costs are indicated between about $3.50 and $5.00 per million Btu. Power generation is examined on the basis of near-term new and retrofitted plants as well as the longer range potential of combined cycle technology.

52441 (COO—0003-40) **Synthane Pilot Plant, South Park Township, Pennsylvania. Run report No. 2-DB: operating period September 1977—September 1978.** (Lummus Co., Bloomfield, NJ (USA)). 1978. Contract EY-76-C-02-0003. 459p. P 20/MF A01.

This report covers the operation of the Synthane Coal Gasification Pilot Plant, South Park Township, Allegheny County, Pennsylvania from September 1977 through September 1978. The facility is owned by the United States Government and operated by C-E Lummus. Test Directive No. 2-DB directed the plant be operated with Illinois No. 6 coal from the River King Mine of the Peabody Coal Company at a pressure of 600 psig. Concurrent pretreater/gasifier operation was to take place at coal feed rates from 1.5 to 2.5 tons/hour. Gas was produced for 182 hours and 1,100 tons of coal were fed to the pretreater and gasifier. Continuous operation of up to 56 hours and carbon conversions based on char of up to 72% were achieved. This successful operation demonstrates that coal gasification via the Synthane Process is viable. Additional data are required for the design of a commercial facility; however, the data obtained to date are adequate to recommend improvements and modifications to the Synthane Process Pilot Plant to increase on stream time efficiency. The successful operation of the pilot plant with Illinois No. 6 coal demonstrates the feasibility of the Synthane Pilot Plant to process a caking type of coal. The ability to successfully pretreat a caking coal at high pressure in a plant of this size is a first and a direct result of the successful operation of the Synthane Process. Other similar type processes operated to date require pretreatment of a caking coal at atmospheric pressure with little or no recovery of the gases or heat produced during pretreatment.

52442 (COO—4196-3) **Energy conservation in coal conversion. Final report, September 15, 1977—September 1, 1978. Selected case studies and conservation methodologies.** Purcupile, J.C. (Carnegie-Mellon Univ., Pittsburgh, PA (USA)). Sep 1978. Contract EY-77-S-02-4196. 566p. P 24/MF A01.

The purpose of this study is to apply the methodologies developed in the Energy Conservation in Coal Conversion August, 1977 Progress Report - Contract No. EY77S024196 - to an energy efficient, near-term coal conversion process design, and to develop additional, general techniques for studying energy conservation and utilization in coal conversion processes. The process selected for study was the Ralph M. Parsons Company of Pasadena, California "Oil/Gas Complex, Conceptual Design/Economic Analysis" as described in R and D Report No. 114 - Interim Report No. 4, published March, 1977, ERDA Contract No. E(49-18)-1975. Thirteen papers representing possible alternative methods of energy conservation or waste heat utilization have been entered individually into EDB and ERA. (LTN)

52443 (COO—4196-3, pp I.1-I.7) **Coal conversion process selection .** McMillin, R.G. (Carnegie-Mellon Univ., Pittsburgh, PA). Sep 1978.

In Energy conservation in coal conversion. Final report, September 15, 1977—September 1, 1978. Selected case studies and conservation methodologies.

Our initial studies on energy conservation in coal conversion were performed by investigating the commercial concept design of the PETC Synthane Process. These studies developed methodologies that can be used to conserve energy in other coal conversion processes. The next step was to select another process where our methods could be applied. The following table is a summary of the processes that we examined and the reasons listed in the remarks column were used to screen the systems. Both the Fischer Tropsch and the SRC II were acceptable systems to study and we arbitrarily chose the SRC II system for further study.

52444 (COO—4196-3, pp II.1-II.51) **Method for computing the optimum economic pipe diameter for Newtonian fluids.** Kramek, R. (Carnegie-Mellon Univ., Pittsburgh, PA). Sep 1978.

In Energy conservation in coal conversion. Final report, September 15, 1977—September 1, 1978. Selected case studies and conservation methodologies.

A closed form relation is presented for calculating the diameter of a pipe line which yields the minimum life-cycle cost for a wide range of fluid parameters and operating conditions. A central consideration in the derivation of the relation is that the optimum diameter should reflect the energy costs for overcoming friction losses. Diameters from the method presented here are compared with a relation developed by DuPont Co. The mean absolute percent difference between the two methods is less than 19%, with the method outlined here yielding larger diameters than the DuPont relation. A 19% increase in diameter represents a 58% decrease in the pumping power required to overcome friction losses.

52445 (COO—4196-3, pp III.1-III.41) **Energy conservation potential in heat recovery techniques. A case study.** Stas, J.D. (Carnegie-Mellon Univ., Pittsburgh, PA). Sep 1978.

In Energy conservation in coal conversion. Final report, September 15, 1977—September 1, 1978. Selected case studies and conservation methodologies.

In this study, we looked at replacing certain heat exchangers with Organic Rankine Cycles. In each case, we determined the cost of generating power and then from this tabulation of capital investment for power generation, feasibility of replacement on a unit-by-unit basis was determined. The results show that 18 heat exchangers reject sufficient heat to warrant ORC usage, with potential electric generation of 36 MW or a 17% increase of the inplant power generation of 210 MW. Cost estimates indicate the capital investment required to be approximately $1000/KW with a potential reduction of $300/KW for mass produced units. Based on the results of this analysis it is recommended that ORC manufacturers be engaged to further engineer and incorporate Organic Rankine Cycles into the Oil/Gas design.

52446 (COO—4196-3, pp IV.1-IV.16) **Alternate de-ethanizer refrigeration system to conserve energy. A case study.** Fucich, L. (Carnegie-Mellon Univ., Pittsburgh, PA). Sep 1978.

In Energy conservation in coal conversion. Final report, September 15, 1977—September 1, 1978. Selected case studies and conservation methodologies.

This study examines an alternate system to cool an ethane gas stream from the fractionator in Unit 18 of the Parsons Oil/Gas Complex. This alternate will save 2.6 x 10^5 Btu/hr of energy or .25 short TPD of coal which is a fraction of a percent of the 36,000 TPD of coal used in the Oil/Gas Complex. The installed cost of the alternate system is $151,000 with an operating and maintenance cost of $7550/yr. Assuming a 20-year life, 9% interest rate on borrowed capital, and an electricity cost of $.025/KW-hr, the Life Cycle Cost of the new system is $179,000 over a 20-year period which shows that more money is spent installing new equipment than is realized from electricity savings. Using a Discounted Cash Flow Analysis, the Return on Investment is 0%.

52447 (COO—4196-3, pp V.1-V.25) **Feasibility study of a combined combustion-gasification facility.** Knestaut, K.R. (Carnegie-Mellon Univ., Pittsburgh, PA). Sep 1978.

In Energy conservation in coal conversion. Final report, September 15, 1977—September 1, 1978. Selected case studies and conservation methodologies.

This work examines the feasibility of mchanical deep cleaning of coal where the cleaned coal would be used for direct combustion and the rejected portion would be used in a coal gasification plant. To make this feasible, the reduced thermal efficiency from gasifying "dirty coal" must be offset by the reduced energy requirement for the flue gas desulfurization system. The study indicated, for the coal being considered for the Parsons Oil/Gas Complex - Illinois No. 6 - the energy saved by reduced flue gas desulfurization was approximately equal to the energy lost from gasifying the dirty coal. The methodology for this study is presented in such a way that other coals - particularly a high pyritic sulfur content - could be studied.

52448 (COO—4196-3, pp XI.1-XI.11) **Energy conservation potential in shaft power generation and distribution.** McMillin, R.G. (Carnegie-Mellon Univ., Pittsburgh, PA). Sep 1978.

In Energy conservation in coal conversion. Final report, September 15, 1977—September 1, 1978. Selected case studies and conservation methodologies.

A criteria for determining the most energy efficient horsepower break-point for using electric motors or steam turbines is developed and applied to the prime movers in the Ralph M. Parsons Co. Oil/Gas Complex. No significant amount of energy can be saved, since the electric motor turbine break-point established by Ralph M. Parsons Co. coincides with the criteria developed in this study. Figure 1 indicates that below 10,000 Hp, an electric motor driver is the more efficient choice; between 10,000 Hp and 15,000

Hp, depending on superheat temperature and condenser vacuum, either motor or turbine driver could be used; and for drivers above 15,000 Hp, turbines would be more efficient.

52449 (FE—1514-88) **Advanced coal gasification system for electric power generation. Third quarterly progress report, April 1-June 30, 1978.** Altiner, H.K.; Chelen, E.J.; Cherish, P. (Westinghouse Electric Corp., Madison, PA (USA). Advanced Coal Conversion Dept.). 30 Nov 1978. Contract EF-77-C-01-1514. 126p. P 07/MF A01.

Operation of the PDU was directed to testing the gasifier reactor. The goals of the testing programs were to evaluate the performance of the gasifier with the expanded free-board section using direct coal feed and to assess the effectiveness of the upgraded gas quench-waste system. These goals were accomplished with Tests TP-015, -016 and -017. Other, more specific test objectives were also realized, and these are described. Heat and material balances as well as product characterization analyses were also accomplished and are included. Over 500 hours of operation were achieved with approximately 270 hours being logged using a highly-caking Pittsburgh seam coal feedstock. High carbon conversions were achieved in all tests with the various feedstocks used. The first operation of the gasifier with the newly-installed oxygen supply system was attempted in Test TP-018-1. Also undergoing initial testing was the modified oxidant tube which was changed to accommodate a reduction in operating pressure from 230 to 150 psig. Experimental tests and analysis of data were carried out on jet phenomena, distributor design, draft tube design and particle entrainment. The jet penetration correlation developed for the multiple vertical jets was compared with published correlations and found to provide improved predictive capability. A comparison of the data and the model is presented. Experiments to study gas entrainment into a jet in the fluidized bed were partially completed.

52450 (FE—1545-56) **Evaluation of design parameters for slagging furnaces for low-Btu gasification of coal for electric power generation. Final report R & D task 3 (phase 1).** Koucky, R.W. (Combustion Engineering, Inc., Windsor, CT (USA)). Jun 1978. Contract EX-76-C-01-1545. 69p. P 04/MF A01.

A study of slagged ash disposal systems for entrained flow coal gasifiers was conducted. The study evaluated the physical and chemical properties of coal ash which are important in the design of slagged ash disposal systems, evaluated past and current experience with slagged ash removal systems and utilized applicable information in the design of the ash disposal system for Combustion Engineering, Inc's process development unit gasifier.

52451 (FE—2012-036) **Pipeline gas demonstration plant, Phase I. Quarterly technical progress report, June—August 1978.** Eby, R.J. (Illinois Coal Gasification Group, Chicago (USA)). Sep 1978. Contract EF-77-C-01-2012. 56p. P 03/MF A01.

Work has continued in the following Tasks of the Pipeline Gas Demonstration Plant Program: Process design studies, trade-off studies and selection of processs were completed and the following Task I Deliverables were submitted to the Department of Energy (DOE); Process Evaluation Report and Revised Conceptual Commercial Plant Baseline. The Conceptual Commercial Plant Design Report, which completes Task I, will be submitted to DOE on September 30, 1978. A Local Resources Survey Report has been submitted to DOE. In accordance with Contract Modification A011, work on Environmental Baseline Monitoring Activities has continued. All other work activity under the contract is still officially suspended in accordance with the Supsension of Work, Article (4) XXXII.

52452 (FE—2012-051) **Pipeline gas demonstration plant, Phase I. Quarterly technical progress report, September—November 1978.** Eby, R.J. (Illinois Coal Gasification Group, Chicago (USA)). Dec 1978. Contract FE-77-C-01-2012. 47p. P 03/MF A01.

Work has continued on the Pipeline Gas Demonstrtion Plant Program. The following Major Contract Deliverables have been submitted to DOE: Conceptual Commercial Plant Design Report; Climatological and Meteorological Report; Preliminary Foundation Investigation and Solid Analysis Report; Site Survey Report, Site Transportation Study Report, Site Water Resources Report, and the Site Environmental Survey Report. With the submittal of the Conceptual Commercial Plant Design Report to DOE on September 28, 1978, ICGG has completed the Task I Work Effort. Other work has progressed at a reduced level of effort in accordance with Contract Modification A011 and as a result of the limitation of available funds. All other work activity under the contract is still officially suspended in accordance with the Suspension of Work, Article (4) XXXII.

52453 (FE—2275-9) **Systems studies of coal coal conversion processes using a reference simulator. Quarterly report, July 1, 1978—September 30, 1978.** Reklaitis, G.V.; Sood, M.K.; Soni, Y.; Overturf, B.W.; Buchanan, P.; Weide, W. Jr.; Wilkinson, C.R.; Boo, J. (Purdue Univ., Lafayette, IN (USA)). Nov 1978. Contract EX-76-C-01-2275. 62p. P 04/MF A01.

The plant capital cost estimation package has been largely implemented. Testing and documentation is projected to be completed by the end of the next quarter. Additions consisting of the physical properties package of entropy estimation capabilities and of automatic selection of the steam table routines when appropriate were made. Significant progress has been made in developing equipment modules for the pyrolysis vapor recovery, heat recovery, bulk methanation, and H_2 plant sections. These modules include an ejector model, an electrostatic precipitator model, an alternate three phase column routine, a multiphase heat exchanger design routine, as well as a steam reformer furnace design program. Case studies have been carried out on the heat recovery section. Integrated simulations of the methanation, vapor recovery, and H_2 plant sections are in various stages of assembly. The hierarchical calculation strategy which is to allow execution of over-all flowsheet simulations in terms of a linked sequence of process section simulations has been demonstrated successfully. An available ethylene oxide/glycol process simulation model was used as a test case. Execution time reductions to 1/3 of the direct simulation time could be shown. Work is in progress in generalizing the interfacing and applying the strategy to portions of the modified COED flowsheet. Successful linkage of the combined pryolysis, gasifier, lift-tube, and combustor models was achieved. These models include detailed kinetics, heat transfer calculations as well as particle balance calculations which allow both particle shrinkage at constant density and reduction of particle density at constant size. Several case studies were run and more are projected.

52454 (FE—2778-8) **Engineering support services for the DOE/GRI coal gasification research program. Quarterly technical progress report, January—March 1979.** Cover, A.E.; Bostwick, L.E.; Gunderson, J.M.; Castiglioni, B.P.; Hubbard, D.A.; Jacks, J.G.; Smith, M.R.; Zeis, L.A. (Pullman Kellogg, Houston, TX (USA)). Apr 1979. Contract ET-78-C-01-2778. 75p. P 04/MF A01.

The objective of this contract is to provide engineering support services to the Department of Energy/Gas Research Institute in the high Btu coal gasification research program. The gasification research program is to determine the specific process and/or combination of component processing steps that offer the greatest economic potential for commercial application. Kellogg's activities during the second quarter of this contract consisted of continued monitoring at the Hygas and Bi-GAS pilot plant sites. Hygas debriefing meetings folloqwing Tests 77 and 78 were attended in Chicago. Trip reports were issued on Hygas Tests 75, 76, and 77, BI-GAS tests G-6E, G-6F, and G-7, and Westinghouse run TP-019-3.

52455 (IS-T—871) **Methanation reaction on ruthenium thin films: a mechanistic investigation.** Slaughter, M.D. (Ames Lab., IA (USA)). Jul 1979. Contract W-7405-ENG-82. 186p. P 09/MF A01. Thesis.

The kinetics of the methanation reaction were measured on thin ruthenium films in the temperature range 548 to 623K. The pressures of the reactant gases were varied over the ranges 1.5 to 1500 μm for CO and 300 to 75000 μm for H_2 to yield kinetic orders for each gas. The CO kinetic order varied from +1 at low pressures to -2 at high pressures. As the H_2 pressure was increased its kinetic order varied from +2 to -1. Both of these order plots had unusually sharp maxima. The reaction is zero order in both CH_4 and H_2O. The apparent activation energy was dependent upon temperature with a value of 21.9 kcal/mole at 573K. Auger spectroscopy (AES) and x-ray photoelectron spectroscopy (XPS) indicated that the surface was always covered with carbon. This carbon could be divided into two types based upon its reactivity toward hydrogen. Type-1 was very reactive to 3.5 torr hydrogen doses at 573K and was completely removed in less than 300 seconds. Type-2 was less reactive and required about 48 hours under the same conditions for removal. No oxygen was ever detected on the surface after methanation. Low energy electron diffraction (LEED) and XPS indicated respectively, that neither graphite nor bulk carbide was associated with the used catalyst. The deposition of up to 0.75 monolayer of carbon enhanced the rate of methanation. More carbon caused a drop in the initial rate. Methanol could be hydrogenated to methane at about the same rate as carbon monoxide. A mechanism was developed which quantitatively fits the kinetic data and qualitatively predicts all of the other observations. This mechanism involves adsorbed hydrogen interacting with non-dissociated carbon monoxide. The rate limiting step involves the interaction of Ru—H and Ru—CH_3 to form methane. A methylene carbonyl hydride is believed to act as a reversible poison at high H_2:CO ratios.

52456 (JPL-TSR—79/6) **Coal pump development and technical support project. Quarterly technical status report, 28 May-1 July 1979.** (Jet Propulsion Lab., Pasadena, CA (USA)). 1979. Contract EF-77-A-01-2616. 32p. P 03/MF A01.

Progress on the assessment of advanced coal gasification processes (Avco-Everett, Bell Aerospace Textron, Rockwell International and Exxon Research and Engineering Co.) is noted. Tests and performance evaluation of several fuel feeding systems are reported. Efforts on the coal pump development have been complet

ed with the successful test of flow control components. Spray test data is being collected. (LTN)

52457 (LETC/RI—79/05) **Material balance: its applications and misapplications in underground coal gasification.** Gunn, R.D. (Department of Energy, Laramie, WY (USA). Laramie Energy Technology Center). Jul 1979. 37p. P 03/MF A01.

The material balance serves as a major tool for the analysis of UCG (underground coal gasification) data; however, it must be used with considerable care. An oxygen balance, for example, can yield spurious and misleading predictions. Both field test data and laboratory experiments are used to show that a method currently used by Cena and previously by other investigators is so unstable that it is not a viable analytical tool. A more restricted form of the material balance is shown to produce good results.

52458 (MIT—2295T9-11) **Computer-aided industrial process design: the ASPEN project. Tenth quarterly progress report, September 1, 1978-November 30, 1978.** (Massachusetts Inst. of Tech., Cambridge (USA)). 15 Dec 1978. Contract EX-76-C-01-2295-009. 99p. P 05/MF A01.

As the task summaries indicate, the major efforts have been in program coding and testing. Parallel coding efforts have been in progress for functional models such as in the UOS, PPS, and Costing systems. Much of the Input Translator and Simulation Program has been programmed, but testing has required more time than estimated. The Input Translator testing has fallen about two months behind schedule and has become the critical path. All other work has continued well and this may result in about only one month overall behind the schedule. The Basic System is planned to be running and tested by early May 1979. Some time was lost in the costing subsystem while negotiating and evaluating cost programs and data to be acquired. We chose to obtain cost correlations and data from Mr. Gus Enyedy of PDQ$. This gives us confidence in delivering a cost system with good, realistic data. The acquired Bureau of Mines program will complement the PDQ$ data in the solids areas. Plans to provide a basic version of costing subsystem have been changed to develop one version - the complete cost subsystem. A more detailed critical path network is in preparation.

52459 (ORNL—5341) **Process designs and economic evaluations for the linked vertical well in situ coal gasification process.** Ulrich, W.C.; Edwards, M.S.;; Salmon, R. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Aug 1979. Contract W-7405-ENG-26. 138p. P 07/MF A01.

Conceptual process designs and cost estimates are presented for three facilities illustrating the following potential applications of underground coal gasification: (1) a 900-MW(e) combined-cycle electric generating plant fueled by low-Btu gas, (2) a substitute natural gas (SNG) plant producing 155 MMscfd of 954 Btu/scf gas, and (3) a synthesis gas (syngas) plant producing 388 MMscfd of gas suitable for further chemical conversion. Designs were based on experimental data and mathematical models from the Laramie Energy Research Center on the linked vertical well (LVW) in situ coal gasification process. In-place coal consumption for the three facilities is 18,073, 22,951, and 22,951 tons/day, respectively, based on a subbituminous Wyoming coal. Respective capital investments were estimated to be $395, $351, and $312 million in first-quarter 1977 dollars. Product prices were calculated as a function of the debt/equity ratio, the annual earning rates on debt and equity, the cost of coal, and plant factor (onstream efficiency). Using a debt/equity ratio of 70/30, an interest rate on debt of 9%, an after-tax earning rate on equity of 15%, a coal feed cost of $5/ton, and aplant factor of 90%, product prices were 19 mills/kWh for electricity, $2.89/$10^6$ Btu for SNG, and $2.48/$10^6$ Btu for syngas. Calculated overall thermal efficiencies for the three facilities were 24, 38, and 40%, respectively, based on in-place coal.

52460 (PB—289940) **Environmental assessment: source test and evaluation report--Chapman low-Btu gasification. Final task report, September 1977—September 1978.** Page, G.C. (Radian Corp., Austin, TX (USA)). Oct 1978. Contract EPA-68-02-2147. 257p. Y A12/MF A01.

The report gives results of a source test and evaluation of a commercial Chapman low-Btu gasification facility. Objectives were to: characterize the multimedia waste streams and potential fugitive emission and effluent streams from the facility, evaluate the applicability of Level 1 sampling and analytical methodology to such a characterization, and evaluate the particulate removal efficiency of the product gas cyclone. All objectives were met; however, Level 1 methodologies required modification in order to do so. Chemical and biological tests indicated that all multimedia waste and process streams examined contained potentially harmful organic and/or inorganic materials; results were generally confirmed by bioassay screening. The product gas cyclone was approximately 60% effective in removing particulate matter from the raw product gas stream.

52461 (UCRL—50026-79-1) **LLL in situ coal gasification project. Quarterly progress report, January-March 1979.** Thorsness, C.B.; Donohue, M.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 May 1979. Contract W-7405-ENG-48. 23p. P 02/MF A01.

Most of the work has centered around the upcoming Hoe Creek No. 3 field gasification experiment scheduled for ignition in July. This includes well drilling, experiment instrumentation, surface plant design, design and implementation of the data acquisition system, and laboratory experiments aimed at understanding reverse burn in a borehole. The design of the process systems for Hoe Creek Experiment No. 3 is essentially complete. We have designed these systems primarily to provide for: the introduction of injection air, steam, and oxygen into the coal seam at controlled and measured rates; the removal, measurement, and disposal of both gaseous and liquid products from the coal seam; and the removal, measurement, and disposal of formation liquids from the base of the coal seam. The prime data acquisition system for the Hoe Creek No. 3 field test will again be based on a minicomputer system. This system will be responsible for the routine retrieval and storage of all relevant process data throughout the experiment. To accomplish this task, computer software has been developed to reliably interact with the major data-gathering hardware to be used during Hoe Creek No. 3. In an effort not directly related to the field test, we studied the economics of methanol and gasoline synthesized from an underground gasification process. A simplified cost estimate shows that methanol and gaoline can be produced from UCG-derived syngas for significantly lower costs than by conventional coal conversion.

52462 **Wear compensating seal means for rotary piston coal feeder.** Gencsoy, H.T.; Gardner, J.F. (to Department of Energy). US Patent 4,142,868. 6 Mar 1979. Filed date 2 May 1978. 8p.

PAT-APPL-902,181.

The present invention is directed to a wear compensating seal arrangement for use in a rotary piston feeder utilized for feeding pulverized coal into a gasifier operating at relatively high pressures and elevated temperatures. The rotary piston feeder has a circular casing with a coal loading opening therein diametrically opposed from a coal discharge and contains a rotatable disoidal rotor having a cylinder in which a reciprocatable piston is disposed. The reciprocation of the piston within the cylinder is provided by a stationary conjugate cam whereby pulverized coal from a coal hopper at atmospheric pressure can be introduced into the cylinder and then discharged therefrom into the high pressure gasifier while maintaining minimal losses of producer gas and the expenditure of minimal energy which would detract from the efficiency of the gasification. The seal arrangement of the present invention is disposed between the rotor and the casing about the coal discharge and prevents the high pressure gases from within the gasifier from escaping between these relatively movable parts during operation of the coal feeder. The seal utilizes a primary seal in contact with the rotor and a secondary seal supporting the primary seal. The primary seal is continuously urged towards the rotor by springs and the high pressure producer gas.

52463 (FE—1734-45(Vol.12)(Bk.2)) **CO_2 Acceptor Process Gasification Pilot Plant: plant operations final report. Final report, Volume 12: Book 2 of 4, January 1972—October 1977.** (Conoco Coal Development Co., Library, PA (USA). Research Div.; Stearns-Roger, Inc., Denver, CO (USA)). 1977. Contract EX-76-C-01-1734. 215p. P 10/MF A01.

The results of the gasification pilot plant operation are reviewed. A brief tabular history which summarizes the pilot plant objectives, major problems encountered, and the accomplishments of each run is presented. Effort is devoted to the analysis of solids fluidization, solids transport, and system pressure balance. Heat and material balances for selected runs, during which steady-state pilot plant operation was achieved, are presented to aid in appraisal of the process. The pilot plant operating program began in April 1972, and ended with the completion of the last run on October 1, 1977. A total of 75 runs were completed in which over 6,400 hours of operating time were logged while at design process temperature and pressure. Over 6,500 tons of dry lignite and subbituminous coal were gasified. Three North Dakota lignites, one Texas lignite, and three subbituminous coals were successfully gasified.

52464 (FE—1734-45(Vol.12)(Bk.3)) **CO_2 Acceptor Process Gasification Pilot Plant: plant operations final report. Final report, Volume 12: Book 3 of 4, January 1972—October 1977.** (Conoco Coal Development Co., Library, PA (USA). Research Div.; Stearns-Roger, Inc., Denver, CO (USA)). 1977. Contract EX-76-C-01-1734. 119p. P 06/MF A01.

This document covers the following sections: development of acceptor reconstitution process, quench tower deposits, methanation system and operating performance, environmental characterization of process, turbine blade erosion tests, and plant innovations and equipment modifications. (DLC)

LIQUEFACTION

REFER ALSO TO CITATION(S) 52424, 52431, 52432, 52433, 52437, 52440, 52442, 52458, 52496, 52497, 52503, 52507, 52509, 52531, 53326, 53504

52465 (BNL—51002, pp 31-39) **Coal liquefaction: process description and effluent characterization.** Schweighardt, F.K. (Dept. of Energy, Pittsburgh, PA). Mar 1979.

From Symposium on assessing the industrial hygiene monitoring needs for the coal conversion and oil shale industries; Upton, NY, USA (5 Nov 1978).

Typical output streams from the conversion of coal to liquid products are summarized: product oil, sulfur, H_2SO_4, ash, carbonaceous residue, water-coal drying, water-waste, spent catalyst, tar, fuel gas (low Btu), sludge, ammonia, spent solvent, coal dust, filter cake, char, light distillates, middle distillates, vacuum distillates, and vacuum bottoms. Five major areas of concern involve: (1) sulfur-containing constitutents; (2) concentrations of polynuclear aromatic hydrocarbons (PAH); (3) concentrations of weakly acidic components; (4) nitrogen heterocyclics; and (5) trace elements. These five major areas of concern can exist in four sample types: (1) gas/vapor; (2) liquids/slurry; (3) solids; and (4) particulates or aerosols.

52466 (CONF-7809162—) **Coal liquefaction.** (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). 1978. 285p. U 13/MF A01.

From Workshop on coal liquefaction; Julich, F.R. Germany (18 Sep 1978).

The workshop, Coal Liquefaction, was held September 18—19, 1978. Eleven papers from the proceedings published by Kernforschungsanlage Julich Gmbh have been entered individually into EDB and ERA. The papers deal generally with coal liquefaction and the Fischer—Tropsch process, with emphasis on the economics. (LTN)

52467 (CONF-7809162—, pp 25p, Paper 3) **Investigations on economics of the Fischer—Tropsch-process for the synthesis of chemical raw-materials.** Hubert, H.J. 1978.

From Workshop on coal liquefaction; Julich, F.R. Germany (18 Sep 1978).

The basic calculations show that in 1975 in Western Europe no FT-process-variant could be run under full cost-recovery. Even if one is able to assume that the FT-synthesis produces ethylene only, the cost-recovery percentage is only a maximum of 75%. The most favorable of todays possible FT-processes, with a cost-recovery percentage of 67%, is the process for the production of olefins with medium-long chains. In order to reach the break-even-point before the year 2000, the price of crude oil must rise at least 3% faster than that of coal. FT-processes for the production of low olefins are competitive earlier. With coal hydrogenation BTX-aromatics are formed. By combination of these two processes it is possible to produce olefins and aromatics from coal. A product range suitable to demand can be produced by employing both processes. Indicated are the tonnages of particular olefins and BTX-aromatics. The consumption of these products in the Federal Republic of Germany in 1976, which amounts to 7.1 million tons is shown. To produce the same tonnage in suitable composition from coal 4.6 million tons would have to be produced with the FT-process and 2.5 million tons by hydrogenation of coal, whereby for the former a Synthol-synthesis was used, followed by a steam cracker, and for the latter a coal hydrogenation process by which the primary product is made aromatic and the remaining aliphatic hydrocarbons are converted in a steam cracker to C_2/C_4-olefins. (LTN)

52468 (CONF-7809162—, pp 15p, Paper 4) **Estimation of economics of a modified Fischer—Tropsch synthesis.** Schnur, F. 1978.

From Workshop on coal liquefaction; Julich, F.R. Germany (18 Sep 1978).

It may be concluded, that - for costs of coal of DM 5 per Gcal and for a return on investment of 7.5 years - the break even point can be reached if the primary products contain 55% of ethylene and propylene at minimum, whereby ethylene as estimated must be favored by 1.8 in relation to propylene. As the desired olefin distribution in favor of ethylene is difficult to achieve, larger gasification and synthesis units are needed to lower the costs, so that either a reduced selectivity of 40% becomes sufficient or equal amounts of ethylene and propylene with a selectivity of 50 to 55% can be tolerated. The need for the required improvement of catalyst selectivity would be markedly restricted if cheaper syngas could be made available. A concluding remark may be added with respect to the diversification of the product program of a modified synthesis. If the gasification process renders syngas rich in methane, it is apparently advantageous to sell the methane as SNG instead of reforming it including the losses of heat which are involved. From the matter of total costs of production it is estimated that about DM 50 per t of primary product may be saved if methane can be sold as SNG to costs of production. Otherwise a concept may be of advantage which comprises the production of short chain olefins in comparatively small reactors run in parallel if cheap syngas from a huge gasification unit can be made available. Special chemicals of high specific value - for instance high boiling paraffins - may be produced at low costs so that the economics of the whole process is favored. (LTN)

52469 (CONF-7809162—, pp 33p, Paper 5) **Chances for production of basic or intermediate chemical products via Fischer—Tropsch process.** Kuehn. 1978.

From Workshop on coal liquefaction; Julich, F.R. Germany (18 Sep 1978).

Due to the relationship between costs and product revenue, the Fischer—Tropsch synthesis is considered to be uneconomic for Europe today. This raises the question: how expensive must the petrochemical raw-material naphtha become to make Fischer—Tropsch material competitive. Within our today naphtha prices, capital costs are practically negligible. On the other hand, they come to about 75% in that naphtha which is derived from the Fischer-Tropsch route. So far such naphtha is less dependent on raw material than the petrochemical one. Favorable as this may sound, it must be borne in mind that today's prices for crude products are not cost-bearing. So that even if the prices of petrochemical naphtha and Fischer—Tropsch naphtha became balanced, the unrationally high capital dependence of a Fischer-Tropsch plant would always bear a high risk, since a competitive product derived from oil can be priced lower at any time as long as oil is available. As an alternative to coal, natural gas could of course be used for synthesis gas production. But, inspite of the considerable lower investment costs, natural gas cannot be considered as an economically competitive raw material. The prospect seems minimal for directing the synthesis for chemical raw materials in a considerably more selective manner, since the influence of the reaction parameters on the product selection appears to be very limited in all processes. By the end of 1975 no substantially improved catalysts had come to light. A characteristic common to all processes is that they produce greater or less quantities of undesired by-products. In a more extended use of the Fischer—Tropsch synthesis a definite limit of marketability is soon encountered. (LTN)

52470 (CONF-7809162—, pp 28p, Paper 6) **Technical and economic comparison of coal liquefaction processes.** Rogers. 1978.

From Workshop on coal liquefaction; Julich, F.R. Germany (18 Sep 1978).

Earlier this year, ESCOE conducted a study of the leading coal liquefaction processes. The purpose of that study was to appraise the commercial viability of each process. A ranking of the process was desired to determine which would yield the best results from further development expenditures. We also have a broader task underway to appraise a variety of coal conversion processes, including some to produce gas and electric power. We report here on partial results from both studies, confining this discussion to liquefaction processes. We discuss three direct liquefaction processes - H-coal, Solvent Refined Coal, and Exxon Donor Solvent - and two indirect processes - Fischer—Tropsch and M-Gasoline via methanol. Both the technical and economic aspects of each process are examined. A standard measure for any process is the thermodynamic efficiency. However, a more useful measure for coal conversion processes is the product's efficiency which is the ratio of the heating value of all fuel products to the energy inputs. Thermodynamic efficiency is a theoretical limit for products efficiency after recovery of all waste heat. The product's efficiency is a good indicator for the amount of resource required to make a specified amount of product. Most of the processes studied are in the development stage. Results of the study are given in tables.

52471 (CONF-7809162—, pp 26p, Paper 7) **Research of capital requirements, costs and economics of a SRC-II-plant under conditions related to the Federal Republic of Germany.** Wolowski, E. (Gesellschaft fuer Vergasung und Verfluessigung von Steinkohle mgH, Bottrop, Germany); Funk, O. 1978.

From Workshop on coal liquefaction; Julich, F.R. Germany (18 Sep 1978).

The capital requirements, costs and economics of a 6,000 st/d SRC II plant under conditions related to the Federal Republic of Germany have been investigated. The total capital requirements of a 6,000 st/d SRC II plant have been estimated with an accuracy range of +- 15% to be more than 800 Mio DM at 1976 money value. The total annual costs on the same pricing basis are 360 Mio DM. This amount includes raw material costs, capital costs and operating costs. The average product price has been estimated to be 272 DM/t. The net costs of production are 90 DM/t higher than this average product price. The results show that an economical operation of a coal liquefaction plant cannot be realized at present.

52472 (CONF-7809162—, pp 15p, Paper 10) **Liquefaction economics direct or indirect routes ?: some considerations.** Baker, A. 1978.

From Workshop on coal liquefaction; Julich, F.R. Germany (18 Sep 1978).

The processes have neither been tested out on any scale nor have they been closed e.g., by assurance of hydrogen production from residual char. Some messages seem clear enough: (a) if gasoline from coal is required, methanol + synthesis looks relatively attractive; (b) burning Fischer—Tropsch liquids as boiler fuels is very uneconomic compared with the intermediate stage of gas use; (c) in general the hydrogenation processes appear to be resembling each other. Thus Exxon Donor Solvent and SRC II may differ in solvent hydrogenation, slurry recycle and treatment of distillation residuals but each has thoughts of possible process revision in the direction of the other; (d) the compatibility of many coal-based liquids (at least those from direct production) with traditional petroleum liquids is in doubt. Overall it is common knowledge that the projected economics of coal liquefaction means that it is not a competitive technology at present or within the near future, except in special circumstances where very cheap coal and strategic reasons justify the costs. In this climate, development in IEA countries is aimed at achieving workable processes where all stages are demonstrably in balance, and in the course of this to obtain firmer information where one process clearly dominates another in providing a generally cheaper product range. As part of this assessment, there is clear interest in finding out under what circumstances different routes to liquefaction (pyrolysis, hydrogenation, synthesis) may be more attractive. As a preliminary stage in our work , an example comparison between hydrogenation and Fischer—Tropsch synthesis is considered. Comparison of processes and routes to liquefaction is made very complicated by the variety of product and valuation of their uses. (LTN)

52473 (CONF-7809162—, pp 29p, Paper 11) **Potential for liquefaction in the US energy market.** Hill, R.F. 1978.

From Workshop on coal liquefaction; Julich, F.R. Germany (18 Sep 1978).

After deducting the effects of coal price escalation and general inflation, the estimated real cost of liquefying coal has still increased from about $0.35/10^6 Btu to about $1.05/10^6 Btu (both in 1970 dollars), some 200%. This increase probably is due mostly to the inevitable rise in cost estimates for new technologies as they evolve from the concept stage to the commercial demonstration stage. In all fairness, although the figure of $0.35/10^6 btu for liquefaction only was generally quoted in 1970, there were some who cautioned at that time the estimates were probably much too low because of the usual optimism in estimating commercial-size plant costs based on conceptual designs. While recognizing the various factors that have contributed to the rising price projections for coal liquefaction, it is most important to appreciate the fundamental contribution of coal prices. Because of the basic market competitiveness of coal with crude oil, liquid fuels from coal will always be more expensive than crude oil in a free market. As crude oil prices increase, coal prices also are going to continue to increase in a free US market in the foreseeable future. (LTN)

52474 (COO—0063-14) **Hydrogen bonding in asphaltenes and coal. Quarterly report for April 1, 1979—June 30, 1979.** Li, N.C.; Tewari, K.C.; Hara, T. (Duquesne Univ., Pittsburgh, PA (USA). Dept. of Chemistry). 16 Jul 1979. Contract EY-76-S-02-0063. 15p. P 02/MF A01.

Structural analyses are reported of upgraded coal-liquids derived from catalytic hydroprocessing of a 30 to 70 blend SRC I with SRC II in a trickle bed reactor under different process conditions. The results indicate that along with the decrease in toluene insolubles, heteroatom (O,N,S) content, aromatic content and corresponding increase in aliphatic content, the hydrogen-bonded structure and phenolic OH content of the coal-liquid drastically decrease with increase in contact time and temperature. The specific gravity, aromaticity, and atomic C/H ratio of the upgraded liquids decrease linearly with the conversion of pentane-insolubles (TI + A) into pentane-soluble oil (HO). Increase in temperature from 672°K to 694°K, under present hydroprocessing conditions, accelerates thermal hydrocracking and increases the conversion of pentane-insolubles, with a marked decrease in specific gravity, viscosity, heteroatom content, and atomic C/H ratio of the upgraded liquid. Hydroprocessing conditions greatly influence the properties of asphaltene fractions.

52475 (COO—0265-3) **Coal cleaning effects during H-Coal catalytic liquefaction of a western Kentucky coal.** Bernard, R.F. (Hydrocarbon Research, Inc., Lawrenceville, NJ (USA)). Dec 1978. Contract EW-78-C-22-0265. 75p. P 04/MF A01.

Two H-Coal bench-scale liquefaction tests were performed to compare the hydroliquefaction behavior of two Kentucky No. 11 coals from the same mine: a run-of-mine coal with 17.49 W % ash and a deep-cleaned coal with 6.21 W % ash. The tests were conducted using a syncrude mode of operation. The deep-cleaned coal exhibited greater coal conversion and greater residual oil yield than the run-of-mine coal. On a dry coal basis, the deep-cleansed coal yielded approximately 19% more C_4 to 975°F distillate than the run-of-mine coal. The process requirement of a pumpable vacuum still bottoms product would result in a 10% higher C_4 to 975°F yield from the deep-cleaned coal than from the run-of-mine coal in a commercial H-Coal plant.

52476 (COO—4196-3, pp XIII.1-XIII.16) **Using second law analysis to pinpoint inefficiencies in coal conversion processes.** Mueller, E.J.; Fucich, L. (Carnegie-Mellon Univ., Pittsburgh, PA). Sep 1978.

In Energy conservation in coal conversion. Final report, September 15, 1977—September 1, 1978. Selected case studies and conservation methodologies.

This report performs a second law analysis on the Fischer-Tropsch Complex of the Ralph M. Parsons Company. A second law analysis, based on the concept of availability, is used to pinpoint and evaluate the dissipations in the F-T complex, and also to determine the efficiency of the complex. The analysis is performed on the entire complex to determine an over-all efficiency, and on the individual process units to reveal areas for improvement. A second law analysis is used instead of a first law (energy) analysis because the results are measured with availability or useful energy and thus are the true efficiencies. Second Law Analysis is based on the concept of availability sometimes referred to as useful energy, potential energy, energy and other names. Any material not in equilibrium with its surroundings has the potential of doing useful work as it approaches equilibrium with its surroundings, and this is the definition of availability. The complex as a whole has a first law efficiency of 70% and a second law efficiency of 68.7%. Two areas where efficiencies could be improved are: unit 14, acid gas removal with a second law efficiency of 80.2%, and unit 21, sulfur recovery, which has a second law efficiency of 66.4%. Other areas had efficiencies greater than 87% which indicates energy recovery and conservation techniques had been implemented in the design of the complex.

52477 (FE—2031-13) **Chemistry and structure of coal-derived asphaltenes, Phase III. Quarterly progress report, July—September 1978.** Yen, T.F. (University of Southern California, Los Angeles (USA)). 1978. Contract EX-76-C-01-2031. 52p. P 04/MF A01.

Preparative scale GPC separation of Synthoil asphaltene was carried out on styrene-divinyl benzene packing (Bio-Beads S-X8). The elution took place in the order of high to low molecular weight. Analyses indicate that aromatic ring systems with large saturated substituents elute first followed by more aromatic molecules with less saturated substituents. Infrared measurements on coal-derived asphaltenes were carried out with a large path cell (1 cm) in order to measure absorbance as a function of concentration in dilute solution down to 0.3 g/l where association between asphaltenes is not significant. VPO molecular weight studies indicate that coal-derived oils and resins undergo very little association in the solvent THF in the range 4 to 30 g/l in contrast to coal-derived asphaltenes and benzene insolubles. Thermal treatment of a Synthoil Coal liquid solvent fraction (oil + resin), in tetralin (1:2 wt. ratio) at 232°C for 20 h resulted in the transformation of 3 to 10% of the oil + resin into asphaltene. These results support the proposed reversibility of coal liquefaction steps. Pryolysis of coal-derived asphaltenes has been shown to produce residues that are characteristic of coalesced mesophase. Asphaltenes from three liquefaction processes, Catalytic Incorporatd SRC, Synthoil, and FMC-COED, were pyrolyzed under a nitrogen atmosphere at 20°C/h to 360°C and at 5°C/h to 420°C. Crossed polarized light reflection micrographs showed a coarse deformed structure for Synthoil asphaltene, a course, but not deformed structure for Catalytic Inc. asphaltne, and a fine isotropic structure for FMC-COED asphaltene.

52478 (FE—2044-41) **Partial liquefaction of coal by direct hydrogenation. Quarterly progress report, October—December 1978.** Falk, A.Y. (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). 1978. Contract EX-76-C-01-2044. 12p. P 01/MF A01.

Construction of the high pressure product recovery system was completed and activation/checkout of this system initiated. Design of a heat recovery quench unit was completed. Facility activation is proceeding well. A preliminary test matrix for the initial Process Development Unit testing is presented. The primary objectives of this testing are to obtain better product recovery, improved process characterization, and longer test durations. The tests will be conducted employing Kentucky No. 9 bituminous coal at reactor temperatures and residence times known to produce high liquid product yields.

52479 (FE—2270-39) **Solvent refined coal (SRC) process operation Solvent Refined Coal Pilot Plant. Quarterly technical progress report, July—September 1978.** Lewis, H.E.; Weber, W.H.; Usnick, G.B.; Hollenack, W.R.; Blair, H.O.; Boykin, R.G. (Catalytic, Inc., Wilsonville, AL (USA)). Mar 1979. Contract EX-76-C-01-2270. 168p. P 08/MF A01.

Operating conditions and test results obtained at the Solvent Refined Coal (SRC) pilot plant in Wilsonville, Alabama during the third quarter of 1978 are summarized. Indiana V coal processing was concluded. The feedstock was changed in September to Kentucky 6 and 11 from Pyro Mining Company's Pyro Mine. A run was completed on Indiana V coal wherein the inventory of dissolver

solids was controlled by use of a bottom withdrawal system. The solids concentration was varied from 5 to 37 lb/ft^3 to study its effects on SRC yield. Operation of the Kerr-McGee Critical Solvent Deashing (CSD) unit was continued. SRC containing 0.06 to 0.75% ash was produced at feed rates as high as 300 lb/hr. SRC recovery ranged from 73 to 84%.

52480 (FE—2305-27) **Investigation of mechanisms of hydrogen transfer in coal hydrogenation. Quarterly progress report, July—September 1978.** Cronauer, D.C.; Ruberto, R.G.; Shah, Y.T.; Modi, R.J. (Gulf Research and Development Co., Pittsburgh, PA (USA)). Oct 1978. Contract EX-76-C-01-2305. 38p. P 03/MF A01.

Experimentation is under way in the study of hydrogen transfer to asphaltenes and coal. About 24% of SRC-I derived asphaltenes were converted to pentane soluble oils when reacted with tetralin at 400°C. The level of hydrogen transfer was about 0.8 g H_2/100 g asphaltenes. This level of hydrogen transfer appeared to be essentially independent of time. Additional experimentation is under way at 425°C and 450°C. Surprisingly, a higher level of oils was formed when mesitylene was used as solvent in the reaction with asphaltenes at 400°C. While little or no hydrogen was being transferred, there did appear to be a reaction of mesitylene with the asphaltenes. Again, this is being checked at higher reaction temperatures. It was observed that the SRC-I derived asphaltenes were relatively unreactive; therefore, experimentation is being undertaken with freshly prepared asphaltenes from runs of low severity - ideally those formed in the preheater. Experimentation with Kentucky 9/14 coal in the sand bath reactor unit has started with runs at 400°C using tetralin or mesitylene as solvents. A series of 8 coal liquefaction runs were made in the continuous unit (CFSTR) using two levels of space time (6 and 12 minutes), two levels of temperature (375 and 400°C), and two coals (Kentucky 9/14 and Illinois No. 6). Two additional points are noted. The plans for remaining experiments have been modified as spelled out herein. The feasibility of using a recently acquired deuterium-NMR for this project is being tested. This is consistent with our own plans and the requests of DOE.

52481 (FE—2893-25) **EDS coal liquefaction process development. Phase IV. Quarterly technical progress report, October 1-December 31, 1978.** Epperly, W.R. (Exxon Research and Engineering Co., Florham Park, NJ (USA)). Mar 1979. Contract EF-77-A-01-2893. 240p. P 11/MF A01.

A liquefaction bottoms recycle study was conducted in the 50 pound-per-day Recycle Coal Liquefaction Unit (RCLU-1). The purpose of this study was to evaluate the effect of bottoms recycle on Exxon Donor Solvent (EDS) liquefaction yields for Illinois No. 6 coal from the Monterey No. 1 mine. Solvent hydrogenation catalyst activity studies to confirm earlier observed effects attributed to feed heteroatom (sulfur, nitrogen, and oxygen) content were completed. These effects, with both Illinois No. 6 and Wyoming coal solvents over Ni/Mo-10 catalyst, were due to high initial catalyst activities and not to the lower Wyoming solvent heteroatom content. Over the ranges tested, the effects of the heteroatoms on the activity of both Ni/Mo-10 and Co/Mo-20 catalysts were negligible. Combustion tests were completed with raw Wyoming (Wyodak) solvent in a home heating oil burner, and with 350/1000°F and 350°F$^+$ fractions, including coker liquids in a 50 hp Cleaver-Brooks industrial boiler. The accuracy of the Generalized Riedel in predicting the vapor pressures of Wyoming coal liquids was examined. As previously found with Illinois coal liquids, this procedure is superior to the Maxwell-Bonnel method in predicting vapor pressures at temperatures above the normal boiling point.

52482 (ORNL/Sub—7186/30) **Liquefaction technology assessment. Final report.** (Parsons (Ralph M.) Co., Pasadena, CA (USA)). May 1979. Contract W-7405-ENG-26. 198p. P 09/MF A01.

A survey of coal liquefaction technology and analysis of projected relative performance of high potential candidates has been completed and the results are reported here. The key objectives of the study included preparation of a broad survey of the status of liquefaction processes under development, selection of a limited number of high potential process candidates for further study, and an analysis of the relative commercial potential of these candidates. Procedures which contributed to the achievement of the above key goals included definition of the characteristics and development status of known major liquefaction process candidates, development of standardized procedures for assessing technical, environmental, economic and product characteristics for the separate candidates, and development of procedures for selecting and comparing high potential processes. The comparisons were made for three production areas and four marketing areas of the US. In view of the broad scope of the objectives the survey was a limited effort. It used the experience gained during preparation of seven comprehensive conceptual designs/economic evaluations plus comprehensive reviews of the designs, construction and operation of several pilot plants. Results and conclusions must be viewed in the perspective of the information available, how this information was treated, and the full context of the economic comparison results. Comparative economics are presented as ratios; they are not intended to be predictors of absolute values. Because the true cost of constructing and operating large coal conversion facilities will be known only after commercialization, relative values are considered more appropriate. (LTN)

52483 (SAND—79-1226C) **Application of radiography to coal liquefaction.** Sample, D.G.; Thomas, M.G. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 16p. (CONF-791008—2). P 02/MF A01.

From ASNT fall conference; St Louis, MO, USA (15 Oct 1979).

X-radiographic techniques have been applied to the investigation of coal and coal liquefaction systems. The analysis of catalysts used in coal liquefaction by wave-length and energy dispersive analyses has identified major contaminants and their distributions. Catalyst tags can be identified and isolated from large numbers of untagged catalysts using film radiography. Another application of film radiography has been the identification of failed systems. A radiation gage has been employed to measure mineral matter in coal and to identify phase boundaries in dynamic systems. The latter is currently being tested for the real time analysis of flow regime in coal liquefaction apparatus.

52484 (TID—28932) **Development and application of analytical techniques to chemistry of donor solvent liquefaction. Quarterly progress report March 1978—May 1978.** Squires, A.M.; Dorn, H.C.; Taylor, L.T.; Dillard, J.G.; Rony, P.R. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). Aug 1978. Contract EF-77-G-01-2696. 32p. P 03/MF A01.

A summary of work performed is as follows: Equipment has been acquired and assembly is well advanced for a batch-stirred microautoclave. An automated elemental analyzer has been acquired and placed in satisfactory operation. The major effort has concentrated upon ascertaining optimum conditions for separating coal conversion products and acquiring further understanding in the employment of ^{13}C nuclear magnetic resonance spectroscopy to coaly matter. Progress in this effort is reported. Additional work is also in hand on ^{19}F nmr characterization of functional groups and on mass spectrometric examination of chromatographic fractions of solvent refined coal. New results in these areas are too preliminary to justify reporting at this time. (LTN)

52485 **Coal liquefaction fundamentals. General papers. Preprints.** Hill, G.R.; Neavel, R.C.; Radding, S.B. Washington, DC; American Chemical Society (1979). 390p. (CONF-790415—P3). Inst. of Gas Technology, 3424 S. State St., Chicago, IL $8.00.

From 177. national meeting of the American Chemical Society; Honolulu, HI, USA (1 Apr 1979).

Papers on coal liquefaction fundamentals are presented. Separate abstracts were prepared for each paper.

52486 **Carbon monoxide—water vs. hydrogen for liquefaction: the reduction of diphenylsulfide, thioanisole and dibenzothiophene.** Baltisberger, R.J.; Stenberg, V.I.; Wang, J.; Woolsey, N.F. (Univ. of North Dakota, Grand Forks). Contract E(49-18)-2211. *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **24**: No. 2, 74-79(1979). (CONF-790415—P3).

From 177. national meeting of the American Chemical Society; Honolulu, HI, USA (1 Apr 1979).

The minerals present in lignite were postulated to catalyze the liquefaction. The relative sources of CO was important because it suggested the economics of using a synthesis gas over hydrogen during liquefaction. For the three sulfur compounds, hydrogen is superior to carbon monoxide—water for desulfurization. The CO—H_2O results were accounted for by the reduction caused by hydrogen from the shift reaction. Since benzoic acid was formed in the reactions of diphenylsulfide and thioanisole only when carbon monoxide was present, it must have been the source of the carboxyl group directly or indirectly. In the diphenylsulfide reductions, carbon monoxide was the source of the methyl group of toluene. The added materials, tetralin, Na_2CO_3 and FeS, exhibit the diphenylsulfide and thioanisole reduction conversions and have little net effect on the dibenzothiophene reactions. Tetralin was not behaving as a good hydrogen donor, but rather as an inert divalent of the reducing gases. Less than 5% of the tetralin was converted into naphthalene. 3 tables.

52487 **High-yield coal conversion in a zinc chloride/methanol melt under moderate conditions.** Shinn, J.H.; Vermeulen, T. (Univ. of California, Berkeley). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **24**: No. 2, 80-88(1979). (CONF-790415—P3).

From 177. national meeting of the American Chemical Society; Honolulu, HI, USA (1 Apr 1979).

Some preliminary work was done with other solvents which were miscible with the $ZnCl_2$. We have discovered that replacing water with methanol as a liquefying agent for the $ZnCl_2$ results in large increases in pyridine solubility of the treated coal. There are several explanations for this effect: improved contacting between the coal and the melt; higher activity of the $ZnCl_2$ in a methanol media;

methylation of cleaved bonds resulting in reduced char formation; and extraction of the reaction products, leaving the coal more accessible. Solubility is linear with hydrogen pressure and time, at constant temperature and methanol charge. There is a strong effect of temperature leading to complete solubility at 275°C in less than 30 minutes. Incorporation is best limited by lower methanol amounts and higher hydrogen pressures. Extractive solvents reduce solubility; donor solvents increase solubility, but involve incorporation. A relation between benzene and pyridine solubility is dependent on wash conditions. Finally, oxygen recovery and corrected solubility are related, the relationship varying with the solvent used. 7 figures, 3 tables.

52488 Pericyclic pathways in the mechanism of coal liquefaction. Virk, P.S.; Bass, D.H.; Eppig, C.P.; Ekpenyong, D.J. (Massachusetts Inst. of Tech., Cambridge). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **24**: No. 2, 144-154(1979). (CONF-790415—P3).

From 177. national meeting of the American Chemical Society; Honolulu, HI, USA (1 Apr 1979).

At typical coal liquefaction conditions, namely temperatures from 300 to 400°C and reaction times on the order of 1 hr, hydrogen transfer from model C10 donors, the Δ^{1-} and Δ^{2}-dialins, to model C14 acceptors, anthracene and phenanthrene, occurs in the sense allowed by the Woodward—Hoffman rules for supra-supra group transfer reactions. Thus, in the conversion of the C14 substrates to their 9,10 dihydro derivatives the dialins exhibited a striking reversal of donor activity, the Δ^{1}-dialin causing about twice as much conversion of phenanthrene but only one-tenth as much conversion of anthracene as did Δ^{2}-dialin. The dialins were also found to be more effective donor solvents than tetralin in the liquefaction of an Illinois No. 6 HVA bituminous coal. For example, at 400°C and 0.5 hr reaction time, Δ^{2}-dialin yielded 16% more pyridine-solubles and 37% more hexane-solubles than tetralin; at 300°C and 0.5 hr reaction time, the Δ^{2}-dialin yielded 5 times the pyridine-solubles and 3 times the benzene-solubles yielded by tetralin. Finally, a mixture containing equal parts of Δ^{1}- and Δ^{2}-dialin was found to be a more effective donor solvent than either of the Δ^{1}- or Δ^{2}-dialins separately. At 400°C and 0.5 hr reaction time, the mixture of donors yielded 18% more pyridine-solubles and 28% more hexane-solubles than the average for the separate donors. The preceding experiments offer preliminary support to our notion that pericyclic pathways might be intimately involved in the mechanism of coal liquefaction. More specifically, the results indicate that pericyclic group transfer reactions constitute a plausible pathway for the transfer of hydrogen from donor solvents to coal during liquefaction. 2 figures, 4 tables.

52489 Isotopic study of the role of a donor solvent in coal liquefaction. Ratto, J.J. (Rockwell International, Thousand Oaks, CA); Heredy, L.A.; Skowronski, R.P. Contract EF-77-C-01-2781. *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **24**: No. 2, 155-165(1979). (CONF-790415—P3).

From 177. national meeting of the American Chemical Society; Honolulu, HI, USA (1 Apr 1979).

This work examined the donor solvent process during coal liquefaction. A deuterium-labeled donor solvent (tetralin-d_{12}) was prepared to study the chemistry of the solvent during liquefaction. In a separate experiment, naphthalene-d_8 was used to investigate the chemistry of hydrogen transfer between coal and a solvent. In each experiment, the coal products and spent solvent were analyzed for total deuterium content and for deuterium content by structural position. The spent solvent mixture was distilled from the coal products, separated by gas chromatography and analyzed by NMR spectrometry. Tetralin can be hydrogenated to form decalins, dehydrogenated to form naphthalene, or rearranged to form methylindan. The pathway of donation of hydrogen by tetralin requires the abstraction of α- and β-hydrogen by coal or gas phase products. Not only hydrogen donation, but also hydrogen exchange via the α-radical of the tetralin can have a significant role in stabilizing the primary free radical structures which form by thermal decomposition of the coal. The Hα position of naphthalene exchanged more of its deuterium with the coal than the H/sub β/ position. With the use of the deuterium tracer method, deuterium incorporation was found in specific structural positions of the solvent and soluble coal products. 3 figures, 5 tables.

52490 Calcium carbonate deposit formation during the liquefaction of low rank coals. Stone, J.B.; Trachte, K.L.; Poddar, S.K. (Exxon Research and Engineering Co., Baytown, TX). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **24**: No. 2, 255-262(1979). (CONF-790415—P3).

From 177. national meeting of the American Chemical Society; Honolulu, HI, USA (1 Apr 1979).

The major findings in the liquefaction work with low rank coals were that oolite formation and wall scale growth were primarily related to coal rank. Both forms of calcium carbonate deposits were detected with every low rank coal tested. As long as the calcium in the coal was present in the humate form, calcium carbonate deposition occurred. The physical withdrawal of solids from the liquefaction reactor did effectively control oolite accumulation and growth but not wall scale. Wall scale can be removed during reactor shutdowns by acid washing. Liquefaction reactor additives were generally ineffective in controlling calcium carbonate deposition. Coal pretreatment, that is, ion-exchange, can be very effective in altering the form of the calcium salt and thus present any type of calcium carbonate deposition in the liquefaction reactor. 3 figures, 2 tables.

PYROLYSIS AND CRACKING

52491 (CONF-7809162—, pp 26p, Paper 8) **Obtaining gas, tar, and oil by degasifying of coal for power stations.** von Diest, G. 1978.

From Workshop on coal liquefaction; Julich, F.R. Germany (18 Sep 1978).

Under the 1975 market conditions in Germany, the LR-process could not be economical. Nevertheless, it appeared expedient to research and to analyze devolatilization processes for a commercial application to recover substitute products. In contrast to other devolatilization processes, the problem of coal caking poses no difficulties for the LR process. There are principal solutions for the purification steps of the crude gas. Experience with the LR process development unit linked with a boiler plant had shown that high temperature operation produces a coal fraction fine enough to be burned in linked power plant boilers. Taking the economic view, only long-range work on the devolatilization problems was recommended in the Project Study. Short-term continuation of the Project would have been practical only for economic reasons or to ensure adequate supplies.

52492 Relation between coal structure and thermal decomposition products. Solomon, P.R. (United Technologies Research Center, East Hartford, CT). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **24**: No. 2, 184-195(1979). (CONF-790415—P3).

From 177. national meeting of the American Chemical Society; Honolulu, HI, USA (1 Apr 1979).

FTIR provided a convenient tool for obtaining quantitative infrared spectra of coals, chars and tars on a dry mineral matter free basis. The spectra of all the coals, chars and tars studied was deconvoluted by varying the magnitudes of a set of 26 Gaussians whose width and position were held constant. This provided a good way for determining magnitudes of individual peaks. Correlation of the magnitudes of the 1600 cm^{-1} peak with the hydroxyl content of a variety of coals, tars and chars indicated that hydroxyl, probably in the form of phenols, contributes strongly to this peak. A regression analysis applied to a series of coals, chars, and tars with widely differing ratios of aliphatic to aromatic hydrogen was used to calibrate the aliphatic and aromatic C—H absorption intensities. The values of aromatic hydrogen for coals derived from the infrared analysis were in reasonable agreement with those of van Krevelen and Mazumdar but are roughly a factor of 2 larger than those derived by Brown. Infrared spectra of a series of coals and tars demonstrated the very close similarity of tars to their parent coals providing further evidence that the tar consists of hydrogen stabilized monomers derived from decomposition of the coal polymer. The variation of functional group concentrations in the products of thermal decomposition was in good agreement with the predictions of a detailed thermal decomposition model. Most of the coal parameters used in the thermal decomposition model could be obtained directly from an infrared, ultimate and proximate analysis of the coal allowing prediction of thermal decomposition behavior from a general set of kinetic constants applicable to lignite and bituminous coals. 12 figures.

SOLVENT EXTRACTION

REFER ALSO TO CITATION(S) 52487, 52488

52493 Effect of coal structure on the dissolution of brown coal in tetralin. Hooper, R.J. (DSIR, Petone, New Zealand); Evans, D.G. *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **24**: No. 2, 89-97(1979). (CONF-790415—P3).

From 177. national meeting of the American Chemical Society; Honolulu, HI, USA (1 Apr 1979).

This work was based on the hypothesis that coal was solubilized into four fractions: the first rich in aliphatics, the second rich in simple aromatics, the third rich in di-aromatics and polar groups, and the fourth rich in polyaromatics. Then reacting each fraction separately allowed the role played by different chemical structures during the hydrogenation process to be examined. The effect that chemical type had on the coal hydrogenation reaction was then studied directly; the hydrogenation process was represented by a composite process made up from the individual reactions of the different fractions. Reacting such fractions individually with tetralin, without any additions of catalyst or gaseous hydrogen was tested. The untreated whole coal was reacted to test whether phenol was having any significant effect on the reaction with the fractions. The contents of the major breakdown products of tetralin were determined by gas-liquid chromatography. A grating infrared spectropho-

tometer was used on the original coal and fractions. The composition of the bottoms product from the dissolution reaction did not depend on the chemical structure of the original coal material. The importance of oxygen groups was stressed. 1 figure, 5 tables.

BY-PRODUCTS

REFER ALSO TO CITATION(S) 53522

52494 (CONF-7809162—, pp 16p, Paper 9) **Upgrading of tar distillates from coal gasification.** Baron. 1978.

From Workshop on coal liquefaction; Julich, F.R. Germany (18 Sep 1978).

The purpose of these investigations was to determine the yield and composition of products obtained by hydrotreating liquid hydrocarbon by-products from coal gasification. Considerable efforts to characterize and classify various tar types obtained by different gasification and carbonization techniques from a representative spectrum of coal grades were followed by studies regarding process selection in the upgrading process scheme. Although final decisions are governed by topical and economical aspects, for example, whether an aromatics recovery or a phenol recovery would be considered or not, the main process route comprises hydrogenation steps to produce automotive fuels. The route of straight hydrogenation with the exclusive production of gasoline and fuel oil in the diesel oil boiling range was selected as a basic criterion for the present work. In a plant for upgrading coal gasification tar, the naphtha (boiling range up to 200°C) and the creosote (boiling range 200 to 460°C) distillate fractions will be hydrotreated separately. The products are hydrogenated naphtha, hydrogenated creosote fuel oil or diesel cut (boiling range 200 to 380°C), light hydrocarons, as methane and C_2 to C_5. The hydrogen consumption of naphtha hydrogenation is 300 to 310 Nm^3/t and that of creosote hydrogenation 400 to 450 Nm^3/t. In the case of a representative feed composition: 1 ton naphtha to 2 tons creosote, the cumulative hydrogen consumption is 3.9 wt % of the feed. Tar distillation residue (boiling range above 460°C) will be obtained. The hydrogenated naphtha is ready for platforming or for prior aromatics recovery determined by economic aspects. The diesel cut has an aromatics content of 70 to 74 wt % and a cetane index of 30. The case of upgrading liquid hydrocarbons from coal gasification discussed here yields hydrogenated naphtha of 73 wt % of the feed. (LTN)

PROPERTIES

REFER ALSO TO CITATION(S) 52450, 52465, 52474, 52484, 52489, 52492, 52493

52495 (BNL—51002, pp 11-29) **Significance of trace constituents in coal.** Ruch, R.R. (Illinois State Geological Survey, Urbana, IL). Mar 1979.

From Symposium on assessing the industrial hygiene monitoring needs for the coal conversion and oil shale industries; Upton, NY, USA (5 Nov 1978).

Discussion is presented on the following topics: distribution of trace elements in US coals, association of trace elements in coal, and mobilities of trace elements during coal conversion (including both gasification and liquefaction processes). (JGB)

52496 (EPRI-EA—1095) **Identification and quantification of polynuclear organic matter (POM) on particulates from a coal-fired power plant.** Griest, W.H.; Guerin, M.R. (Oak Ridge National Lab., TN (USA)). Jun 1979. 95p. P 05/MF A01.

In Part I of this work, stack ash was compared with electrostatic precipitator hopper ash (ESP ash) and 0 to 3.3 μm sized fraction of the latter to determine if ESP could be used to predict the identities of constituents, particularly polycyclic aromatic hydrocarbons (PAH), adsorbed on stack ash. Physical and elemental comparison of stack ash with gross and sized ESP ash suggested that the sized ESP ash was a better model of stack ash. Chemical characterization of the stack and sized ESP ash indicated a strong adsorptivity for aromatics paralleling PAH ring size. The benzene extracts of the ashes contained a series of n-paraffins, and the sized ESP ash contained approximately four times more than the stack ash. Only a brief examination of the PAH content was possible with the small amounts of ash available and the trace (ng/g) levels of PAHs present, but the results suggested that the sized ESP ash was similar in PAH content to the stack ash. The sized ESP ash appears to be useful as a qualitative, but not quantitative, surrogate for constituents adsorbed on stack ash. Further studies should include an investigation of the gas phase constituents. Additional studies in Part II led to the separation and characterization of multialkylated PAHs from a coal liquefaction product. The findings of significant microbial mutagenesis for these PAH derivatives led to a more detailed examination of PAHs in ESP hopper ash. PAHs with 3 and 4 rings plus simple alkyl or phenyl substitution predominated in a PAH isolate from the ash, but very few multialkylated PAHs were observed. Sub-ng/g levels of PAHs were measured.

52497 (FE—2035-13) **Enthalpy measurement of coal-derived liquids. Quarterly technical progress report, July-September, 1978.** Kidnay, A.J.; Yesavage, V.F. (Colorado School of Mines, Golden (USA)). 1 Dec 1978. Contract EX-76-C-01-2035. 16p. P 02/MF A01.

Experimental measurements were completed on a naphtha sample (1046) furnished by the Pittsburg and Midway Coal Mining Company. A total of 38 measurements were made in the temperature region 148 to 459°F, and at pressures of 100 and 300 psia. Additional analytical work was also completed on the SRC-I naphtha whose enthalpy measurements were reported in previous progress reports. Comparisons are given between the experimental SRC-I naphtha enthalpies and the available petroleum enthalpy correlations.

52498 (FE—2316-9) **Study of the mineral matter distribution in pulverized fuel coals with respect to slag deposit formation in boiler furnaces: phase 1. Interim report, April-June 1978.** Austin, L.G.; Shoji, K.; Moza, A.K.; Singh, S. (Pennsylvania State Univ., University Park (USA). Dept. of Materials Science and Engineering). Jan 1979. Contract EF-76-S-01-2316. 26p. P 03/MF A01.

Four samples of H.V. bituminous (Upper Freeport, PA), bituminous(Ill. No. 6), sub-bituminous (School, WY) and lignite (Wilcox, TX) coals were subjected to quantitative emission spectrometric analysis. Two different techniques to analyze coal particles on polished sections using the SEM under computer control are in progress. The furnace characterization tests at 39.3kW (10 lbs/hr) at 10% fuel-rich, stoichiometric and 10% excess air conditions showed flat temperature profiles and peak wall temperatures ranging from 1220°C to 1330°C. The gas temperatures are about 180°C higher than the wall temperatures in the maximum region of the lower portion of the furnace. Ash balance tests showed that the estimated percentage distribution of the ash and slag was approximately 16 to 27% collected at the furnace base, ~ 0.3 to 2.5% leaving as fly ash in the flue gas and ~ 73 to 82% as wall slag. The probe surface of a newly constructed water-cooled, slag deposition probe could be controlled with 5 to 15°C in the temperature range of 200 to 600°C, while in the furnace. The sticking behavior of ash pellets from four coals was tested on a mild steel substrate. The sticking temperatures ranged from 430 to 500°C and adhesion strengths from 50 to 5000 g/cm^2 at 600°C. Various tests using pellets made of a synthetic mixture of powdered mineral matter showed no effect of the particle size of the material making up the pellet and no effect of the height of fall of the drop to the substrate on adhesion force. It was observed, however, that a larger pellet give a lower sticking temperature and higher adhesion forces.

52499 (ORNL/MIT—289) **Surface properties of magnetically separated coal components.** Yu, P.P.; Makarewicz, M.A. (Massachusetts Inst. of Tech., Oak Ridge, TN (USA). School of Chemical Engineering Practice). 22 Mar 1979. Contract W-7405-ENG-26. 32p. P 03/MF A01.

Surface properties of paramagnetic components of Illinois No. 6, Kentucky No. 9, and Wyodak coals were studied using gravimetric and calorimetric techniques to identify differences in surface characteristics when compared with unseparated coals. Equilibrium uptakes of gases such as N_2, O_2, and H_2O were measured, and the kinetics of sorption were investigated. Heats of immersion into liquid H_2O were also measured after outgassing coal samples at room temperature.

52500 **Structural characterization of coal: lignin-like polymers in coals.** Hayatsu, R.; Winans, R.E.; McBeth, R.L.; Scott, R.G.; Moore, L.P.; Studier, M.H. (Argonne National Lab., IL). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **24**: No. 1, 110-120(1979). (CONF-790415—P2).

From 177. national meeting of the American Chemical Society; Honolulu, HI, USA (1 Apr 1979).

Although lignins are major constitutents of vascular plants from which coals are derived, their roles in the coalification process have not been defined. On the basis of chemical and biological degradations, lignins are considered to be polymers of propylphenyl compounds, coniferyl alcohol and related alcohols. Because of their great abundance, high resistance to biological degradation and characteristic occurrence in lplants, isolation of coal degradation products related to these lignin compounds should shed some light on the roles, if any, played by lignins during coalification and in the final structure of coals. To date such studies have had only limited success. Although fulvic and humic acids have been degraded successfully with alkaline solutions to produce lignin-related phenols, this method has not proved to be useful for coals. Many oxidative degradations have also been carried out to break coal down into simpler species; however, isolation and identification of phenols such as p-hydroxybenzene derivatives, vanillic and syringic groups, which are characteristic lignin oxidation products, have not been definitely confirmed yet. In general, commonly used oxidants de-

stroy phenolic rings or give complex products. Some of the oxidants such as nitrobenzene produce reaction by-products that may interfere with the analysis of the oxidation products. To obtain lignin oxidation products from coals, we resorted to the alkaline cupric oxide oxidation method which has been successfully applied to analysis of lignins in plants, fulvic and humic acids, and land-derived marine sediments.

52501 Characterization of hydrolytically solubilized coal. Winans, R.E.; Hayatsu, R.; McBeth, R.L.; Scott, R.G.; Moore, L.P.; Studier, M.H. (Argonne National Lab., IL). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **24**: No. 2. 196-207(1979). (CONF-790415—P3).

From 177. national meeting of the American Chemical Society; Honolulu, HI, USA (1 Apr 1979).

From the characterization of the hydrolytically solubilized coal with glycols the following observations can be made: (1) The polycyclic aromatic rings are being reduced. A possible mechanism is hydride transfer from the solvent. Also oxygen heteroaromatics are destroyed. (2) Arylalkyl ethers are being cleaved by this process. (3) The ability of the glycols to chelate the positive alkali metal ion could contribute to the enhanced yields of soluble coal compared to other protic solvents. This study demonstrated the utility of using a multi-pronged analytical and chemical approach to the study of nonvolatile coal products. 5 figures, 3 tables.

52502 ^{13}C, ^{2}H, ^{1}H NMR and GPC study of structural evolution of a subbituminous coal during treatment with tetralin at 427°C. Franz, J.A. (Pacific Northwest Lab., Richland, WA). Contract EY-76-C-06-1830. *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **24**: No. 2, 263-269(1979). (CONF-790415—P3).

From 177. national meeting of the American Chemical Society; Honolulu, HI, USA (1 Apr 1979).

The dissolution of subbituminous coal occurred very rapidly to produce predominantly phenolic aromatic or aryl ether structures associated with about an equivalent amount of aliphatic structure with molecular weights typically around 1000, and as high as 30,000. The ^{13}C NMR spectra showed the products to possess a wide variety of structures in the chemical shift regions of diaryl and triaryl methanes and ethanes, cyclic and acyclic saturated hydrocarbons, with insignificant oxygenated aliphatic, carbonyl or quinoidal structure. Oxygenated aliphatics, if present, were destroyed in the first 10 min of reaction. The hydrogen transfer process occurred initially at aliphatic sites, but is soon incorporated in aromatic structure, as indicated by ^{2}H NMR results. The ^{1}H NMR resulted confirmed the gradual production of aromatic structure during the reaction. The incursion of condensation reactions was reflected in a gradual upswing of average molecular weights beyond 1 hour reaction times, as well as a small but definite drop in hydroxyl group content in the coal products. 5 figures, 2 tables.

52503 Use of acetylation to quantitate acid groups in coal derived liquids. Baltisberger, R.J.; Patel, K.M.; Stenberg, V.I.; Woolsey, N.F. (Univ. of North Dakota, Grand Forks). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **24**: No. 2, 310-316(1979). (CONF-790415—P3).

From 177. national meeting of the American Chemical Society; Honolulu, HI, USA (1 Apr 1979).

Acetylation was used as a means of measuring quantitatively the fraction of acidic protons in coal derived products. The similarity of the fractions of acidic protons measured by acetylation techniques with those of acid-base titration data suggested that no alcoholic groups were present in the SRL and SRC samples. The acetylation process greatly increased the dissolubility of the coal derived substances in benzene and chloroform. NMR spectra, nonaqueous titration, acetylation and acidic-proton analyses were conducted on refined lignite and refined Amax and Tacoma coals. 3 tables.

52504 Effects of T_1 and NOE considerations in quantitative applications of carbon-13 NMR to the analysis of complex hydrocarbon mixtures. Alger, T.D.; Pugmire, R.J.; Hamill, W.D. Jr.; Grant, D.M. (Univ. of Utah, Salt Lake City). Contract ER-78-S-02-5006. *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **24**: No. 2, 334-338(1979). (CONF-790415—P3).

From 177. national meeting of the American Chemical Society; Honolulu, HI, USA (1 Apr 1979).

In order to overcome the many problems of C-13 NMR, the authors obtained T_1 and NOE values (spin-lattice relaxation times and Nuclear Overhauser Effect) on a number of model compounds (polycyclicaromatic, hydroaromatic, and alkylated aromatic hydrocarbons) which were thought to have representative values similar to those found in complex hydrocarbon mixtures. The T_1 and NOE values thus obtained provided valuable information on relaxation processes, range of values expected, and details of molecular motion. T_1 and NOE data were obtained on naphthalene, tetralin, acenaphthene, pyrene, symmetrical hexahydropyrene, phenanthrene, 1-8 octahydrophenanthrene, xanthone, and phenyloctane. This group of compounds represented a set of structural types representative of many moieties known to occur in coal derived liquids. In terms of general relaxation considerations the data is considered in terms of protonated and non-protonated carbons. Relaxation constraints were much less severe at high fields than those encountered using iron core magnet NMR technology. Based on experimental data, the non-protonated carbons at C-15,16 in pyrene represented the longest T_1 values one would expect to encounter. By using mixtures of these compounds, varied spectrometer operating conditions were used on coal derived liquids to arrive at an optimal set of parameters. 1 table.

52505 Interactions of gases with coal: structural inferences. Fuller, E.L. Jr. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **24**: No. 2, 358-363(1979). (CONF-790415—P3).

From 177. national meeting of the American Chemical Society; Honolulu, HI, USA (1 Apr 1979).

The mode of interaction of gases with coal from the standpoint of analyses related to the structure of coal and implications pertinent to mechanisms of fluid phase reactions were studied. The coal, high-volatile A bituminous Illinois No. 6, was obtained at the mine face and stored in argon prior to grinding in argon. Dealing with steady-state conditions, based on kinetic continuity and accountability, the desorption retention was attributed to structural changes induced in the coal matrix. Based on other studies, the morbid swelling properties of coal, even on CO_2 and CH_4 sorption, the existence of a fixed definable pore structure and/or internal surface area of coal must be questioned. Further analyses on this and coals of varied rank are warranted. 5 figures.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 52426, 52433, 52447, 52450, 52481, 52496, 53148, 53410, 53468, 53637

52506 (ANL/ECT—4) Current and advanced NO/sub x/-control technology for coal-fired industrial boilers. (KVB, Inc., Tustin, CA (USA)). Dec 1978. Contract W-31-109-ENG-38. 200p. P 09/MF A01.

A NOx-control-technology assessment study of coal-fired industrial boilers was conducted to examine the effectiveness of combustion-modification methods, including low excess air, staged combustion, and burner modifications. Boiler types considered included overfed and underfed stokers, spreader stokers, pulverized-coal and coal-fired cyclone units. Significant variations in NOx emissions occur with boiler type, firing method, and coal type; a relative comparison of emission-control performance, cost, and operational considerations is presented for each method. Baseline (as-found) emissions from grate-fired stokers were shown to be in the range of 200 to 300 ppM. Similarly, as-found emissions from suspension-fired units were quite low (350 to 600 ppM) as compared to comparably designed utility-sized units. Low excess air was shown to be the most effective method on existing units, reducing emissions by approximately 10%. Evaluation of staged combustion and burner modification, however, were limited due to current boiler designs. Major hardware modification/design and implementation are necessary before the potential of these techniques can be fully evaluated. The study emphasized the numerous operational factors that are of major importance to the user in selecting and implementing a combustion-modification program, including energy considerations, incremental capital and operating costs, corrosion, secondary pollutants, and retrofit potential.

52507 (COO—4579-1) Preliminary evaluation of PETC-coal conversion solid and hazardous wastes. Progress report, September 15, 1977—September 30, 1978. Neufeld, R.D.; Shapiro, M.; Chen, C.; Wallach, S.; Sain, S. (Pittsburgh Univ., PA (USA)). 30 Sep 1978. Contract EY-77-S-02-4579. 49p. P 03/MF A01.

This progress report reviews issues and local area practice relative to the disposal of small quantity laboratory solid and chemical wastes from the PETC site. Research efforts to date have been in two major directions, a) solid and hazardous waste problems relative to PETC, and b) solid and hazardous waste problems relative to coal gasification and liquefaction conversion processes. It is intended that bench scale coal conversion processes located at PETC be considered as small but typical models for residuals sample generation. A literature search activity has begun in order to develop a data bank of coal conversion residual characterizations, and identify other centers of hazardous waste handling research expertise.

52508 (EPA—600/7-78-002) Engineering/economic analyses of coal preparation with SO_2 cleanup processes for keeping higher sulfur coals in the energy market. (Hoffman-Muntner Corp., Silver Spring, MD (USA)). Jan 1978. Contract ET-75-C-01-9025. 252p. P 12/MF A01.

The economic analyses covering physical desulfurization of coal followed by flue gas desulfurization and flue gas desulfuriztion used alone for selected coal source-user combinations indicate that economic generalizations must be approached with caution. The range of variability is such that each case must be individually

assessed. In general, available data indicate that many coals can be beneficiated to remove ash and sulfur at an attractive net cost. These coals with reduced ash and sulfur content levels are often not too far removed from the sulfur content levels required to meet environmental standards in some areas traditionally served by these coals. When coal can be physically cleaned to a level not too far removed from that required to meet emission standards, flue gas desulfurizttion treating only a portion of the flue gas would satisfy environmental constraints. In many cases the net cost of physical desulfurization followed by flue gas desulfurization is substantially less than that of flue gas desulfurization alone. This is due to the net economics associated with physically cleaning coal combined with the substantially lower flue gas desulfurization costs. In essence, the net cost (i.e., costs less benefits) associated with physical desulfurization would be less than the additional cost if flue gas desulfurization was used alone. For existing powerplants, the real costs for flue gas desulfurization systems are especially expensive owning both to higher capital costs and to the shorter economic lives of the systems. In many such cases, the use of physical desulfurization followed by flue gas desulfurizttion can be particularly attractive.

52509 (FE—2635-T2) **Conceptual designs for water treatment in demonstration plants. II. Appendix - design procedures.** Seufert, F.B.; Hicks, R.E.; Wei, I.W.; Goldstein, D.J. (Water Purification Associates, Cambridge, MA (USA)). Mar 1979. Contract EF-77-C-01-2635. 219p. P 10/MF A01.

In making six conceptual water treatment designs, several design procedures are necessarily used several times. The design procedures used frequently are described in the following appendices. It is hoped that each appendix will enable an engineering reader to duplicate our design and to decide for himself whether our design equations are acceptable. A text book type of report is being written and will be issued by the US Environmental Protection Agency, Research Triangle Park, North Carolina, very soon (Contract 68-03-2207).

52510 (FE—9005-1) **Recovery of fine-size waste coal. Final technical report, May 1978.** Browning, J.S. (Alabama Univ., University (USA)). Nov 1978. Contract ET-76-G-01-9005. 52p. P 04/MF A01.

The Mineral Resources Institute and State Mine Experiment Station of The University of Alabama surveyed existing waste impoundments in Alabama to determine their location, the approximate quantity of coal in each waste pond, and the amount of recoverable coal based on washability tests of representative samples of the waste. Humphreys spiral tests were conducted on Alabama fine coal waste from nine preparation plants of surface mining operations, and from nine preparation plants of underground mining operations. The ash in the samples ranged from 9 to 51%, with a total sulfur content of 0.42 to 1.29%. Coal recoveries (float 1.60 specific gravity) of 84 to 98% were achieved from the different samples. In quality, the products were comparable or superior to those now being shipped from the preparation plants.

52511 (HCP/T2549—30) **Development of potential uses for the residue from fluidized bed combustion processes. Quarterly technical progress report, July 1979.** Minnick, L.J. (Department of Energy, Washington, DC (USA). Div. of Fossil Fuel Utilization). Jul 1979. Contract EF-77-C-01-2549. 27p. P 03/MF A01.

Some significant differences in loss on ignition and calcium content have been noted between two AFB residue samples received from the fluidized bed unit in Windsor, Connecticut. Although the majority of the calcium in the first sample is present in a carbonate form, the calcium in the second sample appears to be present primarily as calcium oxide. Analysis of AFB fly ash samples from Alexandria, Virginia; Alliance, Ohio; and Windsor, Connecticut reveals significant variations in the gradation and chemical composition of these materials, particularly with respect to loss on ignition, silica, and calcium content. Test reslts for stabilized road base compositions at various moisture levels have shown that peak strength development and maximum mix density occur at moisture contents somewhat greater than normal optimum moisture levels. Some significant volume expansions were observed in various types of stabilized road base mix samples. Increases in moisture content in excess of optimum compactible levels was not successful in alleviating the extent of volume change. Laboratory studies of Proctor-size cylinders and mortar bar specimens using materials from the Ohio road base demonstration confirmed that detrimental volume expansions were found in specimens containing Alliance AFB residue, while specimens containing Battelle AFB residue showed little or no expansion. Significant volume changes have also been observed in three of the four test plots containing various levels of AFB residue in stabilized road base formulations. The test plot containing a comparatively low level of AFB residue is the only one that has not shown obvious signs of expansion. Initial results of a computerized study of sludge dewatering and disposal using AFB residue indicate that potentially significant cost savings may be realized by the addition of AFB residue to wastewater sludge prior to disposal.

52512 (PB—291369) **Pollution control guidelines for coal refuse piles and slurry ponds. Final report, December 1975-July 1977.** (Wahler (W.A.) and Associates, Palo Alto, CA (USA)). Nov 1978. Contracts EPA-68-03-2344;EPA-68-03-2431. 278p. Y A11/MF A01.

A large percentage of the eastern coal mined today is washed and processed to remove impurities and increase quality. The wastes from the preparation process pose a serious disposal problem. The study investigated acid and heavy metal ion concentrations in water passing through refuse piles, suspended solids in waters from refuse areas and slurry ponds, noxious gases from oxidation and fires in refuse piles, and airborne particulates from dry exposed refuse surfaces.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 52460, 52465, 53638, 53665, 53733, 53739

52513 (CONF-790672—3) **Constraints to increased coal use.** Surles, T.; Hoover, L.J.; Goldberg, A.J. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 4p. P 02/MF A01.

From International symposium on modeling, planning, and decision in energy systems; Montreux, Switzerland (19 Jun 1979).

The results of an assessment of potential constraints to increased coal production and use in the United States are presented. This broad-based assessment considered the effects of increased coal use on air quality, water quality and availability, local public services, public and occupational health, and national economics. Local and regional constraints found to be potentially significant include: increased public service costs in Rocky Mountain communities, violations of water quality standards, water availability in the Midwest and Rocky Mountains, nonattainment of air quality standards, solid waste disposal sites and costs for urban industry, health impacts of high ambient atmospheric sulfate levels, and uncertain effects of recently-enacted national environmental legislation. Strategies for overcoming such constraints are now being evaluated.

52514 (EPA—600/7-77-130, pp 35-61) **Environmental perspectives.** Oxley, J.H.; Smithson, G.R. Jr. (Battelle's Columbus Labs., OH). Aug 1978.

From Conference on coal cleaning - an option for increased coal utilization; Arlington, VA, USA (24 May 1977).

If physical cleaning of coal will produce a product which will meet environmental regulations, it should be employed. There is no other technology developed today that can compete on a cost basis. It also should be considered as a technology in combination with others. The basic question to be answered not only in the control of sulfur during the combustion of coal, but in control of all pollutants involving control technology in general, is how much are we willing to pay for the improved quality of our environment? Somewhere before we get to absolute environmental control, there must be an optimum cost-benefit level which has yet to be satisfactorily defined by society. Until we can define such a cost-benefit goal, we will continue to drift without firm objectives which can be understood by all our citizens. (LTN)

52515 (IS-T—866) **Impact of surface coal mining and reclamation on the hydrogeology at Iowa Coal Project Demonstration Mine No. 1, Mahaska County, Iowa.** Stangl, D.W. (Ames Lab., IA (USA)). Jul 1979. Contract W-7405-ENG-82. 329p. P 15/MF A01.

Thesis.

The groundwater effects of surface mining at ICP No. 1 can be classified primarily as water quality and water quantity effects. The water quantity effects are: the loss of groundwater saturation in spoil materials that were initially removed from over the coal and later replaced; the dewatering of high permeability geologic strata up gradient of mining area; the increase in porosity and possibly permeability in refilled spoil materials; and the change in groundwater gradients in mined areas and near the sediment pond. The water quality effects are: the generation of slightly mineralized enclaves near the sediment pond and spoil accumulations; the generation of thin zones of highly mineralized water near the base of reclaimed spoil probably due mostly to remnant acid mine water; and reduction of water quality in coal seams as a result of dewatering at the time of mining and subsequent oxidation of their pyrite content. Most effects of water quantity loss in and around the mine are not permanent. Water quality disturbances of the fringe areas of reclaimed mine areas will be very slow in attenuating because of the slow groundwater flow through these materials. Adulterated groundwaters in high permeability areas such as the flood plain alluvium will be more quickly attenuated than those in the mine spoil areas, but these enclaves also have the potential to effect much larger areas due to more rapid groundwater movement. Reduced pH and alkalinity were observed in very restricted areas near the east side of the sediment pond.

52516 (LA-UR—79-1834) **ROCKY: an energy-environment model of coal and electricity supple in Rocky Mountain West.** Bivins, R.; Kolstad, C.; Loose, V.; Pendley, R.; Stein, M. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 33p. (CONF-790747—1). P 03/MF A01.

From Coal modeling conference; Bozeman, MT, USA (25 Jul 1979).

The Rocky Mountain states of the American West are frequently cited as a potential breadbasket of domestic energy resources. This eight-state region contains about half of the US coal reserves, most of the high-grade uranium ores, almost all of the prime-grade oil shale deposits, and very large reservoirs of geothermal energy. In addition, existing oil and gas production contributes significantly to national production, and the potential for solar applications seems substantial. Understandably, the region has attracted great attention in long-range planning for energy resource development, with some future estimates showing very large increases in the amount of energy extracted, converted, and exported from the region. However, because of its small population and relative lack of development, the region also possesses another characteristic of increasing value to the Rocky Mountain States and to the nation: a clean environment. Most of the air and water resources in the region have not suffered the degree of pollution found in more populated parts of the nation. The very attempts on the part of national decision makers and analysts to plan for future energy development in the region have given rise to a large number of organized attempts to delay, advance, control, relocate, or in some other manner to influence the course of energy development in the region. The motivation for this analysis and modeling effort was a desire to conduct a detailed, quantitative investigation of a crucial aspect of the issues mentioned above: the effect of regional coal development and electricity generation on the region's environment, and the (potentially) limiting effects that environmental protection measures, especially air-quality standards, might have on such development.

52517 (PB—290146) **Reclamation and revegetation of strip mined land: a selected bibliography of publications in the University of Minnesota forestry library. Bibliography series.** Albrecht, J. (Minnesota Univ., St. Paul (USA). Forestry Library). Jun 1978. 18p. Y A02/MF A01.

This report is a bibliography of nearly 200 references relating to the reclamation and revegetation of strip mined land with the emphasis on tree planting. There is an appendix entitled 'Environmental Effects of Mining in Minnesota'. This bibliography supplements one published by the Forestry Library in 1976.

RESERVES AND EXPLORATION

REFER ALSO TO CITATION(S) 52574, 53759

52518 (DOE/EIA—0064) **Coal data: a reference.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Sep 1978. 25p. NTIS, PC A03/MF A01.

This report is a compilation of information about coal. It was prepared to help answer general inquiries concerning coal reserves (as of January 1, 1976), production, productivity and consumption exports, imports (all for 1947 to 1977). Included in the report are basic data that show important trends in the coal industry.

MINING

REFER ALSO TO CITATION(S) 52515, 52518

52519 (DOE/EIA—0102/2) **Estimated impact of the 1978 UMWA contracts on the cost of mining coal. Analysis memorandum AM/ES/78-10.** Thompson, B.C.; Edwards, M.W. (Department of Energy, Washington, DC (USA). Energy Information Administration). Jun 1978. 31p. Q 03/MF A01.

This analysis points up not only the major impact of productivity assumptions on the estimated cost of coal but also the indicated significance of regional variations. The large increase in coal production in the 1960's has been followed by a period of major changes in the industry in the 1970's. The latter include significant shifts in the method, size, and location of mining. Additionally, the past five years have witnessed a large decline in the share of coal production accounted for by the UMWA. Accordingly, there is a real need for greater study of the impact of the above developments on productivity-bach short-term and longer range. This conclusion is pointed up by the major shifts in productivity between 1968 and 1976 that are shown in the previously cited Table B.

52520 (PB—289757) **Propagation of EM signals in underground mines. Final report, 2 August 1976-30 Septembr 1977.** Cory, T.S. (Rockwell International Corp., Richardson, TX (USA)). Sep 1977. Contract H0366028. 158p. Y A08/MF A01.

The report is a comprehensive summary of the results of the propagation measurements program conducted for the Bureau of Mines. Data were gathered in the medium frequency range from a cross sample of six mines representative of the industry having typical wireless requirements. From the raw data which was gathered, a logical method of data reduction is presented which culminates in a set of average attenuation characteristics for all mines visited. These characteristics define a typical MF wireless system when the communication range requirements are known. Direct through-the-earth propagation and the range enhancement mechanism due to coupling on and off conductors are evaluated and related to the planning of a typical wireless MF communications system.

52521 (UCRL—52586) **Analytical modeling of coal mine roof behavior.** Langland, R.T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Oct 1978. Contract W-7405-ENG-48. 99p. P 05/MF A01.

A comprehensive series of three-dimensional, finite-element calculations of roof behavior at three different sites in a room-and-pillar coal mine have been performed. The calculated results have been compared with experimental results obtained in an extensive in situ field measurement program. The parameters studied were roof sag (relative displacement between roof strata), roof-bolt load change, and roof-to-floor convergence. The study included a wide range of extraction ratios (27 to 80%). A series of parametric studies were performed for one of the sites, including: changing the viscoelastic time parameter; varying the preload on the bolts; and changing the effective stiffness of the bolts. The good agreement between analysis and field experiments shows that three-dimensional, finite-element modeling of mining can be an extremely useful tool for understanding mine behavior. Some general conclusions reached on the basis of the analysis are: significant movement occurs in the rock mass during excavation (all finite-element modeling should include excavation to get reliable results); accurate geometry and accurate material properties are essential; roof-bolt anchor movement determines a bolt's effective stiffness and, consequently, the amount of load change a bolt will experience; movement of the rock as a continuum is not influenced by the bolts (they merely follow the deformation of the rock mass); the cause of convergence could not be determined (pillar softening, floor heave, or a combination of the two might be responsible); the roof sag and bolt-load change showed no long-term, time-dependent behavior; and the convergence rate between the floor and the roof was highest immediately after excavation. (After approximately 30 days, a steady rate, equal to about one-third of the original convergence rate, was achieved).

52522 **Determination of a foam's dust suppression parameters in coal combine operations.** Romenskii, L.P.; Shishatskii, A.G.; Grinev, V.M. *Izv. Vyssh. Uchebn. Zaved., Gorn. Zh.;* No. 10, 76-79(1978).

The effect of specific dust formation and dust surface on the specific expenditure of foam-former and foam solutions was established. In order to maintain hygienic standards of dust level, the productivity of the foam-generating apparatus (in volume) must exceed the productivity of the combine by 3.5 to 7.0 times. Computational formulas are presented for determining the necessary amount of foam with variable multiplicity factors. 2 references, 1 figures, 1 table.

TRANSPORT AND HANDLING

REFER ALSO TO CITATION(S) 52426, 52427, 52430, 52456, 52462, 52475, 52510

52523 (FE—2722-4) **Effects of minerals on coal beneficiation processes. Quarterly report No. 4, July 1-September 30, 1978.** McMillan, B.G.; Buttermore, W.; Muter, R.B.; Slonaker, J.; Simonyi, T.; Grady, W. (West Virginia Univ., Morgantown (USA). Coal Research Bureau). 29 Nov 1978. Contract EF-77-S-01-2722. 39p. P 03/MF A01.

Field samples from the District 7 preparation plant were collected at the plant site in southern West Virginia, and transported to Morgantown for processing. Bulk samples of feed coal, refuse, and clean coal were sampled from hoppers and belt lines, and initial processing prior to characterization was begun. Arrangements to sample an Illinois preparation plant have been completed and this work will be conducted during the fifth quarter. Additional characterization data from the District 3 preparation plant samples are included in this report and the status of the pilot scale preparation plant beneficiation equipment and initial testing is discussed.

52524 (FE—9001-1) **Surface phenomena in the dewatering of coal.** Keller, D.V. Jr.; Stelma, G.J.; Chi, Y.M. (Syracuse Univ., NY (USA). Dept. of Chemical Engineering and Materials Science). Jan

1979. Contract ET-75-G-01-9001. 186p. (EPA—600/7-79-008). P 09/MF A01.

The influence of certain surfactants on the dewatering of fine coal has been investigated. The surfactants investigated were found to have a two-fold effect. They were found to effect the pressure differentials required for dewatering in addition to the residual water contents of the coal beds attainable by this dewatering. Both effects were attributed to surfactant adsorption. Adsorption at the liquid-air interface resulted in a decrease in the interfacial tension between the two phases. The effect this decrease had on the pressure differentials required for dewatering was found to be in agreement with that predicted by the capillary theory applied to the system. Adsorption at the solid-liquid interface was correlated with the complex behavior of the residual water contents as a function of surfactant addition. A comprehensive model for the adsorption of the surfactants onto the coal was presented, based on the Stern—Grahame theory of adsorption at an electrical double layer. The model allowed for the mode of physisorption to change as the amount of surfactant adsorbed increased, and also for a phenomenon known as hemimicellation. Using the model, consistent and reasonable results were found for the specific surface area of the coal and for the standard free energies of adsorption. The model was also found to be appropriate when the heterogeneous nature of the coal was considered. Furthermore, the hydrophobicity of the molecular groups of the molecules, expected from the model to be controlling the hydrophobicity of the interface, was found to be in agreement with that predicted by other means.

52525 (PB—289937) **Water transportation requirements for coal movement in 1985. Final report August 1976—August 1977.** Witten, J.M.; Desai, S.A. (Input Output Computer Services, Inc., Cambridge, MA (USA)). Dec 1978. Contract DOT-TSC-1282. 114p. Y A06/MF A01.

This study of transportation requirements for coal movements through 1985 is one of a series conducted for the U.S. Department of Transportation to identify and quantify future transportation requirements for energy materials. The primary objectives of the study were to develop a scenario for 1985 coal production and consumption and to project water coal traffic equipment and facilities requirements consistent with the scenario. A second objective was to identify the planning processes used by the water carriers to identify and prepare for future traffic. The third objective of the study was to identify potential constraints to and institutional issues impacting increases in water coal traffic and the ability of the water carriers to handle it profitably.

52526 (PB—290150) **Rail transportation requirements for coal movement in 1985. Final report, August 1976-August 1977.** Witten, J.M.; Desai, S.A. (Input Output Computer Services, Inc., Cambridge, MA (USA)). Dec 1978. Contract DOT-TSC-1282. 160p. Y A08/MF A01.

The primary objectives of the study were to develop a scenario for 1985 coal production and consumption, and to project rail coal traffic volumes and equipment and facilities requirements consistent with the scenario. A second objective was to identify the planning processes used by the railroads to identify and prepare for future traffic. The third objective of the study was to identify potential constraints to the institutional issues impacting increases in rail coal traffic and the ability of the railroads to handle it profitably.

COMBUSTION

REFER ALSO TO CITATION(S) 52442, 52447, 52481, 52498, 52513, 53146, 53638

52527 (FE—2489-40) **Development of combustion data to utilize low-Btu gases as industrial process fuels. Project 61004 special report No. 6: high-excess-air burner.** Waibel, R.T.; Fleming, E.S. (Institute of Gas Technology, Chicago, IL (USA)). Mar 1979. Contract EX-76-C-01-2489. 44p. P 03/MF A01.

Data were collected to evaluate the performance of a high-excess-air type burner when retrofit with low-Btu gases. The burner, a North American Model 4422-7 XSA, was fired on the IGT pilot-scale test furnace with a load simulating a section or zone of a refractory kiln. The low-Btu gases simulated for these commbustion trials were Koppers—Totzek oxygen (KTO), Wellman—Galusha air (WGA), and Winkler air (WA) fuel gases. KTO exhibited no flame stability problems at a 3 million Btu/hr firing rate with excess air levels from 10% to 77% - the maximum air flow our blower could attain. KTO did not require a burner pilot for stability. WGA fired at 3 million Btu/hr was stable with a pilot flame at excess air levels from 10% to the blower maximum, which was 65% excess air for WGA. With no pilot flame, WGA blew off in all cases. With the pilot, WA, at 3 million Btu/hr, did not have a stable flame, even with only 10% excess air; however, at 2.5 million Btu/hr WA had a stable flame at excess air levels from 10% to the maximum, 97%, with the pilot on. Blowoff occurred when the pilot was extinguished. KTO, with 50% excess air, gave a higher thermal efficiency and peak flame temperature than natural gas with the same excess air level. WGA fired at 10% excess air performed as well as the natural gas with 50% excess air in terms of thermal efficiency and exceeded natural gas in radiant flux. WGA, however, had a flame length about 3 times that of natural gas. WA at 2.5 million Btu/hr, 10% excess air had the same thermal efficiency (25%) as natural gas exhibited at 3.0 million Btu/hr with 50% excess air, but had lower gas temperatures and radiant flux.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 52440, 52459, 52467, 52468, 52469, 52470, 52471, 52472, 52473, 52518, 53145

52528 (DOE/EIA—0103/1) **Short-term coal demand model. Technical memorandum TM/ESA/78-01.** Cohen, B.N.; Mabee, J.S.; Uri, N.D. (Department of Energy, Washington, DC (USA). Energy Information Administration). Nov 1977. 22p. Q 03/MF A01.

The Coal Analysis Division of the Office of Energy Source Analysis of Energy Information Administration has developed a Short Term Coal Demand Model (STCDM) for use by the Federal Government and interested outside groups. This model provides quarterly forecasts of electrical generation and coal consumption or three years at the state level. This report summarizes the development and design of the model. The electric utility sector is the largest consumer of coal, accounting for approximately 75% of the total demand for bituminous coal in recent years. Consequently, accurate modeling of this sector is essential for forecasting the demand for coal. Various econometric problems and structural irregularities exist, however, that must be taken into account in the final specification. The demand for coal by electric utilities is dependent on the demand for electricity, coal-fired generating capacity, and the relative costs of generating electricity using alternate boiler fuels. Thus, as the demand for electrical energy increases, for whatever reason, the demand for coal used to generate electrical energy would also be expected to increase. Many factors affecting the decisions of electric utilities in their choice of fuel mix and operating options cannot be easily quantified. Some examples are given.

52529 (EPA—600/7-77-130, pp 11-15) **Importance of coal in meeting national energy needs.** Loesch, H. (Peabody Coal Co., St. Louis, MO). Aug 1978.

From Conference on coal cleaning - an option for increased coal utilization; Arlington, VA, USA (24 May 1977).

In 1920, we produced over 560 million tons of coal from 9,000 mines, all by hand, and all but 1 percent or so from underground. It took almost 650,000 miners to do this, producing as they did about 4 net tons per man, per day, and working an average of 220 days. Kicking and clawing and trying to survive through the '50's and '60's, with total annual production decreases almost year by year - losing its best customers and finding its new customers most difficult to handle - the industry survived by maintaining its price level and increasing its productivity. By 1969, we were about back to where we were in 1920 in tonnage, very little above in value, producing from only 5,000 mines. With 125,000 miners employed, we were, by the aid of immense and costly machinery, digging 20 tons of coal per day per man, half of it from surface mines. During the interim, the industry had barely managed to keep its head above water by changing from a labor-intensive to a capital-intensive process. And by meeting the demands of price, it sowed the seeds of obloquy and criticism. During much of this time, government policy was all price, and its own agencies, like TVA, demanded the lowest possible penny per ton - and the hell with the land, the air, or the water. The government says it wants us to produce in excess of a billion tons of coal annually by 1985. The industry's projections indicate that it will do so. Perhaps without any margin at all. But what is produced is a function of what can be sold, as well as the function of lead times, investment, transportation, and labor force. Although these factors are all mixed together, along with others which more directly concern our customers, let us try to examine them in order. (LTN)

52530 (EPRI-EA—496(Vol.3)) **Economic analysis of coal supply: an assessment of existing studies. Final report.** Gordon, R.L. (Pennsylvania State Univ., University Park (USA). Dept. of Mineral Economics). Jun 1979. 286p. P 13/MF A01.

This report is the fourth in a series on work relating to coal supply. Emphasis is on important extensions that have occurred to work treated in earlier volumes in this series. In particular, efforts by ICF, Inc., Charles River Associates, and Martin B. Zimmerman, the last both independently and in collaboration with Data Resources, Inc. are examined. Three coal supply models - those of National Economic Research Associates, Energy and Environmental Analysis, Inc., and the Argonne National Laboratories - and a world

energy model developed by a group at the Virginia Polytechnique Institute and State University are reported for the first time. The report also covers a wide variety of other coal studies including several important surveys of the coal market in general, examination of competition in the coal industry, coal mine costing analyses, and assessments of regional impacts of coal industry development. The report also provides a discussion by the principal investigator of the principal problems in predicting coal industry developments.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 52433, 52465, 53729, 53748

52531 (BNL—51002) **Proceedings of the symposium on assessing the industrial hygiene monitoring needs for the coal conversion and oil shale industries.** White, O. Jr. (ed.). (Brookhaven National Lab., Upton, NY (USA)). Mar 1979. Contract EY-76-C-02-0016. 333p. (CONF-781150—). P 15/MF A01.

From Symposium on assessing the industrial hygiene monitoring needs for the coal conversion and oil shale industries; Upton, NY, USA (5 Nov 1978).

This work was supported by the United States Department of Energy, Division of Biomedical and Environmental Research, Analysis and Assessment Program, through the Safety and Environmental Protection Division at Brookhaven National Laboratory. The symposium program included presentations centering around the themes: Recognition of Occupational Health Monitoring Requirements for the Coal Conversion and Oil Shale Industries and Status of Dosimetry Technology for Occupational Health Monitoring for the Coal Conversion and Oil Shale Industries. Sixteen papers have been entered individually into EDB and ERA; six had been entered previously from other sources. (LTN)

52532 (BNL—51002, pp 107-118) **Industrial hygiene experience in coal liquification (an overview).** Runion, H.E. Mar 1979.

From Symposium on assessing the industrial hygiene monitoring needs for the coal conversion and oil shale industries; Upton, NY, USA (5 Nov 1978).

An outline is presented. Topics for discussion are: Solvent Refined Coal (SRC) Plant - Fort Lewis, Washington; Gulf industrial hygiene and environmental monitoring proposal - objectives; scope of study; implementation - field studies - DOE contract, January 1976; implementation - laboratory support; methods and procedures; SRC-I vs SRC-II processes; health education for employees. (JGB)

52533 (BNL—51002, pp 119-143) **Occupational safety and health in coal gasification.** Evans, J.M. (Enviro Control, Inc., Rockville, MD). Mar 1979.

From Symposium on assessing the industrial hygiene monitoring needs for the coal conversion and oil shale industries; Upton, NY, USA (5 Nov 1978).

Steps taken in the development of a criteria document for occupational safety and health considerations in commercial coal gasification plants are traced. It is concluded that employment in a coal gasification plant may entail exposure to a number of chemical compounds that may be toxic and/or carcinogenic. However, it was the consensus that there is insufficient evidence to develop new permissible levels of exposure to toxic substances. It is recommended that, where applicable, existing Federal occupational exposure limits be enforced. (JGB)

PETROLEUM

REFER ALSO TO CITATION(S) 53468

GEOLOGY AND EXPLORATION

52534 (DOE/EIA—0102/7) **Analysis of the productivity of domestic petroleum exploration activities.** Frederiksen, M.J. (Department of Energy, Washington, DC (USA). Energy Information Administration). Jul 1978. 59p. Q 04/MF A01.

This paper addresses the recent decline in the productivity of domestic petroleum exploration activities. Its purpose is to present data on the recent changes in the productivity of domestic exploration activities and to provide an analysis of a number of underlying economic relationships that are likely influencing the trends in exploration activity. There is suggested a research agenda whose purpose would be to discern the transitory effects that the sudden increases petroleum prices have had on exploration activities.

52535 (METC/EGSP—802) **Map of Indiana showing reported oil and gas shows from 100 feet of strata overlying New Albany shale.** Bassett, J.L.; Hasenmueller, N.R. (Indiana State Dept. of Natural Resources, Indianapolis (USA). Geological Survey). 1979. Contract EY-76-C-05-5204. 16p. P 02/MF A01.

52536 (METC/EGSP—803) **Map of Indiana showing reported oil and gas shows from the New Albany shale.** Bassett, J.L.; Hasenmueller, N.R. (Indiana State Dept. of Natural Resources, Indianapolis (USA). Geological Survey). 1979. Contract EY-76-C-05-5204. 16p. P 02/MF A01.

52537 (METC/EGSP—804) **Map of Indiana showing reported oil and gas shows from Middle Devonian carbonate rocks.** Bassett, J.L.; Hasenmueller, N.R. (Indiana State Dept. of Natural Resources, Indianapolis (USA). Geological Survey). 1979. Contract EY-76-C-05-5204. 16p. P 02/MF A01.

DRILLING AND PRODUCTION

REFER ALSO TO CITATION(S) 52421

52538 (BETC—0008-5) **Research on surfactant-polymer oil recovery systems. Project status report, January 1-March 31, 1979.** Shah, D.O.; Walker, R.D. Jr. (Florida Univ., Gainesville (USA)). Sep 1979. Contract EW-78-S-19-0008. 80p. P 05/MF A01.

Progress is reported in three areas: interfacial phenomena, thermodynamic properties, and rock/fluid interactions. (DLC)

52539 (CONF-790805—12) **Micellar-flood research. Chemicals, phase behavior, and adsorption on minerals.** Johnson, J.S. Jr. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 15p. Dep. NTIS, PC A02/MF A01.

From DOE symposium on enhanced oil and gas recovery and improved drillings technology; Tulsa, OK, USA (22 Aug 1979).

Problems in field production of biopolymers motivated much of the research during this period aimed at lowering cost of micellar-flood chemicals. Various procedures for wet separation of polymers from fermentation broth and removal of plugging constituents were evaluated. Alternative microorganisms which produce glucan were tested. Prior contact of montmorillonite or crushed Berea sandstone with bleach-plant effluents from the kraft process was found to reduce markedly adsorption of petroleum sulfonate surfactants; presence of the effluent appeared to have little effect on the interfacial tensions of surfactant-containing systems. Measurements of miscibilities of aqueous-organic systems modelling micellar floods were extended to higher alkyl substitution of protosurfactants, to mixtures of hydrocarbons, and to lower protosurfactant concentrations. Equilibria of Na(I) and Ca(II) between aqueous solutions and several clays were determined over a range of composition. Exchange appears to a first approximation ideal, with the exception of unexpected loading effects at low loadings of one of the ions on some of the solids. Measurements have begun on Na(I)/Mg(II) systems. Adsorptions of ions which earlier appeared promising as tracers on montmorillonite are now being measured on hydrous oxides.

52540 (DOE/MC/05602—6) **Acquisition, classification, and evaluation of engineering and geologic information and characteristics of West Virginia petroleum reservoirs amenable to enhanced oil recovery technology, particularly carbon dioxide injection. Final report.** Pease, R.W. (Gruy Federal, Inc., Houston, TX (USA)). Jul 1979. Ccntract ET-78-C-05-5602. 220p. P 09/MF A01.

Based on available reservoir information, CO_2 displacement seems to be the enhanced oil recovery technique most suitable for most West Virginia oil reservoirs. Seventeen reservoirs have been identified as potential candidates for the CO_2 displacement process: three Berea, six Big Injun, five Gordon, one Gordon Stray, one Fifth, and one Squaw—Weir sand reservoir. The total volume of oil remaining in these 17 reservoirs is estimated to be more than one billion barrels. The fields are all within a relatively small geographic area and constitute a significant target for enhanced oil recovery technology. There are, however, many difficulties in working with expensive fluids in old fields containing many abandoned wells. Injectivity of liquid CO_2 in West Virginia oil reservoirs has been demonstrated to be higher than that for water or natural gas. In connection with raising pressures prior to CO_2 injection, waterflooding has been shown to be effective in two reservoirs previously considered impossible to flood. In the single CO_2 displacement process completed in West Virginia, the Granny's Creek project, efficiency of recovery was not high: less than one barrel of additional oil per 20 MSCF of CO_2 injected. The injected liquid was found far outside the project area, however, indicating a need for effective confinement. The CO_2 process has been demonstrated as effective in displacing oil from a previously waterflooded portion of the reservoir. The three ongoing or projected CO_2 projects in the state have many common features, which should simplify the complete analysis when they are completed.

52541 (ORO—5301-38) **Oil recovery by carbon dioxide injection. Quarterly report, October—December 1978.** SanFilippo, G.P.; Watts, R.J. (Pennzoil Co., Vienna, WV (USA); Department of Energy, Morgantown, WV (USA). Morgantown Energy Technology Center). Jun 1979. Contract EF-76-C-05-5301. 48p. P 03/MF A01.

This report is the thirty-eighth report on the progress of the Rock Creek carbon dioxide project in Roane County, West Virginia. Injection of carbon dioxide was scheduled to begin in the fourth quarter of 1978. The need to eliminate the thief zone problem caused a three month delay. This problem was rectified, but contract negotiations for a carbon dioxide supply at an increased price will delay carbon dioxide injection further. Start-up of carbon dioxide injection is scheduled to begin in February 1979. The response to waterflood declined significantly during this quarter. The center producing wells are now producing near a 100% water cut, therefore, the waterflood portion of the project is basically over. Any significant oil production from now on will be attributed to carbon dioxide injection. Water injection continued without incident during the quarter. As of January 1, 1979, 1,604,617 barrels of water have been injected. Pressure fall off tests indicate a reservoir pressure of 1000 psig which is sufficient for miscibility.

52542 (SAN—1809-9) **Interfacial effects in the recovery of residual oil by displacement: studies at Northwestern University. Annual report, March 1, 1977—February 28, 1978.** Slattery, J.C.; Kovitz, A.A. (Northwestern Univ., Evanston, IL (USA)). Jun 1978. Contract ET-78-S-03-1809. 136p. P 07/MF A01.

One analysis has been completed and another is advancing concerning the relative effects of the interfacial viscosities and interfacial tension during displacement. A new correlation has been developed for the dynamic contact angle as a function of capillary number. New techniques have been developed in interfacial viscometry. The meniscal breakoff interfacial tensiometer has evolved into a reliable instrument. The effects of adsorption upon the measurement of interfacial tension in the meniscal breakoff, spinning drop, and sessile drop tensiometers is better understood.

52543 (SAN—1809-12) **Interfacial effects in the recovery of residual oil by displacement: studies at Northwestern University. Annual report, March 1, 1978—February 28, 1979.** Slattery, J.C.; Kovitz, A.A. (Northwestern Univ., Evanston, IL (USA). Dept. of Chemical Engineering; Northwestern Univ., Evanston, IL (USA). Dept. of Mechanical Engineering and Astronautical Sciences). Mar 1979. Contract ET-78-S-03-1809. 37p. P 03/MF A01.

Goal is to determine the effects of the interfacial viscosities, interfacial tension, advancing contact angle, and receding contact angle upon the relative permeability and capillary pressure functions. It appears that in single pores the interfacial viscosities may play a major role in displacement, assuming that the interfacial tension has been reduced below the critical value required for movement. A set of interfacial tension measurements was completed for a pre-equilibrated octane/1 wt % brine, N wt % Witco TRA 10 to 80 system ($0 \leqq N \leqq 5 \times 10^{-2}$). Results from meniscal breakoff and spinning drop tensiometers are compared as a function of pre-equilibration mode (also angular speed and drop volume in the case of the spinning drop tensiometer). For a fixed N, the steady-state interfacial tension depends upon pre-equilibration mode, angular speed and drop volume in our spinning drop tensiometer; the meniscal breakoff instrument yields scattered results ranging over the steady-state values obtained by the spinning drop method.

52544 (SAND—79-0593C) **New perspective on well shooting: the behavior of contained explosions and deflagrations.** Schmidt, R.A.; Boade, R.R.; Bass, R.C. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 11p. (CONF-790913—5). P 02/MF A01.

From 54. annual technical conference and exhibition; Las Vegas, NV, USA (23 Sep 1979).

Explosive charges are sometimes detonated in wellbores in efforts to stimulate production of gas or oil; often these efforts meet with little or no success. In this paper, attention is given to the physical phenomena which control the dynamic response of rock to deeply buried charges. The description of the mechanical behavior of rock focuses on the creation of an impermeable cage of residual stresses that develops around the charge, impedes fracturing induced by explosive gases, and can actually reduce the flow of fluids into the wellbore. The general description of the pertinent physical processes is applicable to most, if not all, rock types as well as to both spherical and cylindrical charges. Results of code calculations, field experiments, and laboratory experiments are presented which support the phenomenological descriptions. The implications that this behavior has on conventional well shooting with explosives are described and several alternatives to current techniques are discussed. These alternatives include the use of modified geometrical configurations, decoupled explosives, explosive gases, and propellants. A gas-fracturing propellent concept is described in some detail.

52545 (SAND—79-1232) **DEEP STEAM Project. Quarterly report, January 1-March 31, 1979.** Bader, B.E.; Fox, R.L.; Johnson, D.R.; Donaldson, A.B.; Krueger, D.A. (Sandia Labs., Albuquerque, NM (USA)). Jul 1979. Contract EY-76-C-04-0789. 31p. P 03/MF A01.

The major objective of DEEP STEAM is to develop the technology required to economically produce heavy oil from reservoirs greater than 2500 feet in depth using steam injection. Current steam flood oil recovery processes are in general limited to shallow (less than 1000 feet) reservoirs because of loss of heat to the formation as the surface generated steam is injected at depth and because the high pressures and temperatures required cause failure of well completion components such as packers. To overcome these limitations, DEEP STEAM is developing two separate technologies: (1) methods of decreasing heat loss from injection strings and improving other well completion components; and (2) a downhole steam generator that will generate the steam and inject it into the formation at depth. This report covers accomplishments during the sixth quarter of the project and is divided into sections on Project Management, Technology, Field Test, and Supporting Activities.

PROCESSING

REFER ALSO TO CITATION(S) 53522

52546 (DOE/EIA—0111/77) **Petroleum refineries in the United States and Puerto Rico.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 1978. 19p. Q 02/MF A01.

Data are presented on crude oil capacity, storage capacity, and cracking, reforming, coking and alkylation capacity of petroleum refineries in the United States and Puerto Rico as of January 1, 1978

52547 **Steam supply to the petroleum and petrochemical industry.** White, I.C. pp 17-23 of Steam at work: industrial and marine steam plant. New York, NY; Mechanical Engineering Publications Limited (1977).

From Conference on steam at work: industrial and marine steam plant; Manadon, Plymouth, UK (10 May 1977).

Steam is an important commodity in the petrochemical industry and to some extent can be supplied by generation within process units. However in most refineries and chemical plants conventional boiler plant is necessary and in some larger plants the total energy concept of combined heat and power generation is adopted. The considerations made in deciding the type of steam and power plant used in the BP organization are discussed. Examples of systems in operation are given and a brief assessment of current developments is made.

PRODUCTS AND BY-PRODUCTS

REFER ALSO TO CITATION(S) 52547, 53311

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 52473, 52557, 53131, 53298, 53299, 53309, 53310, 53312, 53313, 53314, 53315, 53316, 53317, 53318, 53319, 53321

52548 (DOE/EIA—0102/4) **Evaluation of future world oil prices.** Kincel, K.L.; Kilgore, C.; Rodekohr, M. (Department of Energy, Washington, DC (USA). Energy Information Administration). 2 Jun 1978. 80p. Q 05/MF A01.

This paper provides a preliminary analysis of the range of possible world oil prices during the 1980's. These preliminary price estimates were developed in support of the preparation of a National Energy Supply Strategy and are subject to change as that study progresses.

52549 (DOE/EIA—0102/6) **Relationship between crude oil price controls and refined product prices.** Isaac, R.M. (Department of Energy, Washington, DC (USA). Energy Information Administration). Jul 1978. 33p. Q 03/MF A01.

This Analysis Memorandum is a response to a request from the Office of Policy and Evaluation for an independent evaluation of recent work done by Charles Phelps and Rodney Smith of the Rand Corporation. The Phelps and Smith proposition is that, because the effects of crude oil price controls are not fully reflected in refined product prices, the proposed crude oil equalization tax would have little or no effect on refined product prices, consumption, or total petroleum imports. This paper focuses on the arguments, assumptions, and implications of the ongoing discussion of the Phelps-Smith arguments.

52550 (DOE/EIA—0102/29) **Factors affecting the decline rate of old oil production.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 7 Jul 1978. 25p. Q 02/MF A01.

The available historical data on old oil production over the period January 1975 to March 1978 are investigated in order to provide a framework upon which reasonable future projections of old oil production levels can be based.

52551 (DOE/EIA—0112(77)) **Sales of asphalt in 1977.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Jul 1978. 6p. Q 02/MF A01.

Data are presented on sales of petroleum asphalt and asphaltic products by type and principal rise C1973-1977) and by P.A.D. District and state (1976, 1977).

52552 (DOE/EIA—0114/76) **Sales of liquefied petroleum cases and ethane in 1976.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Jan 1978. 12p. Q 02/MF A01.

Data on sales of liquified petroleum gases and ethane in 1976 are presented in tabular form. Liquefied petroleum gases include propane, normal and other butanes, isobutane, and butane-propane mixtures. Sources of these liquefied gases are natural gas processing plants, refineries, and imports.

52553 (DOE/EIA—0184/9) **Analysis of the world oil market. Analysis report.** Weigel, H.S.; Sandoval, A.D. (Department of Energy, Washington, DC (USA). Energy Information Administration). Jul 1979. 36p. P 03/MF A01.

This analysis considers some of the suggested reasons for the petroleum shortfall in 1979 and examines the degree to which the proposed explanations are supported by existing data. Data from 1974 to the present on oil production, net imports, and stocks for the United States are compared with similar data for other major consuming and producing countries. Several factors combined to cause the recent petroleum shortage, but the overriding factor was the shortfall caused by the Iranian disruption. US supplies are sensitive to import levels because domestic production, after receiving a temporary boost from Alaskan output, appears to have leveled off again in 1978 and, in fact, is experiencing a slight decline (240,000 barrels per day) in the first quarter of 1979. The US petroleum shortfall seems to have been intensified by several other factors. Stocks were drawn down extensively in early 1978, in large part due to price-related maneuvers. Attempts to build up stocks in the latter part of 1978 were then hindered by the Iranian disruption. The data does not support a hypothetical continuing gradual embargo by OPEC. The stock situation may have been worsened further by an international effort to maintain world price stability through suggestions of restraint in purchasing from the spot market. Restraint was not uniform among the consuming nations. Net import figures for the first quarter of 1979 indicate that the US obtained a relatively small share of the additions to world oil supplies. Restraint efforts were eventually relaxed by some US refiners as well, as needs grew to build stocks to minimum acceptable levels. The need to build up stocks for the winter months and at the same time provide gasoline for the heavy driving season resulted in lines at the pumps in many areas of the country.

52554 (HCP/I5725—01) **Simulation study of eight petroleum supply disruption scenarios.** Schink, G.R. (Wharton (E.F.A.), Inc., Philadelphia, PA (USA)). Apr 1979. Contract EI-78-X-01-5725. 151p. P 08/MF A01.

The cost of an oil embargo in terms of lost real output (GNP) is less than proportional to the reduction in oil supplies but still substantial. As the size of the oil embargo increases, the percentage loss in GNP increases relative to the percentage loss in oil supplies (a nonlinear relationship). Price levels increase during an embargo partly in response to higher world oil prices and partly as a result of the disruption (inefficiency) inherent in any supply constrained situation. While standard capacity utilization measures would fall during an embargo, there would be no incentive to cut prices because output would be limited by oil inputs. (In general, firms would be producing all they could produce).

52555 (LBL—8874) **Aggregated vectorial model of petroleum flow in the United States.** Krishnan, V.V.; Cahn, D.F. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1979. Contract W-7405-ENG-48. 90p. P 05/MF A01.

An aggregated material-flow model is proposed for crude oil and its derivative products. The purpose of this model is to isolate stages in petroleum flow where material conservation is expected from those where volumetric or identity changes can occur, and to identify generic properties of petroleum and petroleum products that would assist in effective data validation. The model also provides a structural framework for organization and consolidation of the various databases related to petroleum, and serves as a guide for analysis and enumeration of explicit semantic data interrelationships. The model is amenable to expansion into both transactional and more disaggregated representations. In the present study, the material-flow model was intended as a preliminary step toward a coherent and comprehensive data structure to support monitoring, forecasting, and regulatory efforts in the energy field. The model is developed in the abstract; no attempt has been made to test it using explicit data.

52556 **Future world oil prices.** Kincel, K.L. (Dept. of Energy, Washington, DC). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **24**: No. 1, 32-38(1979). (CONF-790415—P2).

From 177. national meeting of the American Chemical Society; Honolulu, HI, USA (1 Apr 1979).

This paper summarizes the major findings of an analysis prepared for the Office of Policy and Evaluation, US Department of Energy. The purpose of the study was to delimit a range of world crude oil prices that might occur between now and 1990. Unlike analyses of most physical systems, analyses of the international energy system are dominated by uncertainty. Two major sources of uncertainty dealt with in this analysis are the future level of OPEC production capacity and future rates of economic growth. Both of these factors affect the balance between supply and demand, hence the price, in the world oil market. In recognition of such uncertainties, the approach taken posits a range of assumptions for each of these factors. Based on the findings of this analysis, it is not unlikely the recent leveling off of real oil prices will come to an end in the next decade. Exactly when oil prices could begin to rise in real terms and to what levels is highly uncertain. It must also be noted that although such increases are likely, they are not inevitable. A number of events, such as extensive energy conservation, accelerated development of new energy sources, or the adoption of aggressive energy policies in the United States and elsewhere could significantly delay another round of escalation in world oil prices. The potential effects of these and other factors are the subject of an ongoing analysis within the Energy Information Administration.

WASTE MANAGEMENT

52557 (BETC—4343-1) **Comparison of sludge separation processes in the BERC used lubricating oil re-refining process. Final report.** (Benham-Blair-Holway and Spragins, Tulsa, OK (USA)). Aug 1979. Contract EY-77-C-02-4343. 34p. P 03/MF A01.

Alternative methods to separate the sludge from the solvent/oil mixture encountered in the BERC Oil Re-refining Process were investigated in the laboratory and in a centrifuge vendor's pilot plant. The test results indicated that a combination of gravity settling to effect a gross separation and centrifugation of the sludge underflow to increase oil recovery would be the best economical situation. Based upon this process change, the budget estimate for the capital and operating costs were revised for a 10-million-gallon per year plant. The revised economic estimates based upon current conditions showed: (1) the total capital requirements would be approximately $2.8 million, (2) the total manufacturing cost would be $0.45 per gallon, (3) the cash flow return on investment before taxes would be approximately 54 percent.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 53655, 53699

52558 (DOE/EIS—0012) **Final environmental impact statement. Petroleum production at maximum efficient rate, Naval Petroleum Reserve No. 1 (Elk Hills), Kern County, California.** (Department of Energy, Washington, DC (USA)). Aug 1979. 531p. Dep. NTIS, PC E08/MF E08.

The Naval Petroleum Reserves were opened up for production at maximum efficient rates (MER) consistent with sound engineering practices, for a period of 6 years. MER production for Naval Petroleum Reserve No. 1 (NPR-1) is expected to peak at between 205,000 and 240,000 bbl/d of crude oil in 1982. The law also provides that the Reserve shall be produced in a manner which will secure maximum hydrocarbon recoveries by injection of residue natural gas and water. Positive impacts of the project would be increased employment, use of vacant housing, increased local spending on goods and services, and the potential for increased domestic petroleum production with a commensurate decrease in the US balance of payment deficit. Adverse effects of the project would include increased air pollution emissions, increased noise levels, reduction in vegetation, loss of the Petroleum Reserve for use in emergency situations, increased traffic levels, and decreased visual quality.

52559 (PB—291278) **Performance testing of selected sorbent booms. Final report.** Smith, G.F. (Mason and Hanger-Silas Mason Co., Inc., Leonardo, NJ (USA)). Nov 1978. Contract EPA-68-03-0490. 38p. Y A03/MF A01.

Performance tests on three commercially available sorbent booms were conducted at the U.S. Environmental Protection Agency's Oil and Hazardous Materials Simulated Environmental Test Tank (OHMSETT) test facility. Test variables included wave condition, tow speed, and quantity of oil encountered. The maximum no-oil-loss containment tow speed was determined for each wave and oil quantity test condition. The no-oil-loss tow speed in calm water was consistently near 0.25 m/s, but in a 0.3-m harbor chop wave, this figure decreased to between 0.05 and 0.1 m/s. In the 0.3-m harbor chop wave, the failure mode was typically droplet shedding from the contained oil slick, whereas in calm water, the oil slick passed under the booms. No sorbed oil appeared to wash out of the booms when they were towed. When saturated boom sections were wrung out, the recovered fluid weighed from 9.5 to 14 times boom dry weight and was 16 to 50 percent oil.

POLICY, LEGISLATION, AND REGULATION

52560 (DOE/TIC—10479) **Preliminary economic impact evaluation of proposed rulemaking to amend provisions of the domestic crude oil allocation program relating to imports of residual fuel oil.** (Federal Energy Administration, Washington, DC (USA)). Jan 1977. 20p. P 02/MF A01.

The proposed rulemaking would amend provisions of the Old Oil Allocation Program, (entitlements program), in order to modify the existing scheme of awarding entitlements for certain importations of residual fuel oil. Purpose is to ameliorate the problems that have been encountered since the adoption of the modifications to the entitlements program in March 1976. This evaluation first considers the economic impacts of the existing system as compared to the system that preceded it. Then the inflationary and other economic impacts of the proposal are considered so that comparisons can be made between the changes proposed and the relevant alternatives.

52561 (EMD—79-57) **Improvements needed in the enforcement of crude oil reseller price controls.** Staats, E.B. (General Accounting Office, Washington, DC (USA)). 29 May 1979. 73p. General Accounting Office, Dist. Section, 441 G Street, Washington, DC.

Report to the Congress of the United States by the Comptroller General.

The Department of Energy needs to strengthen its enforcement procedures and practices covering crude oil resellers' compliance with crude oil price controls. The Department should: develop written procedures for handling criminal cases which will assure (1) timely and meaningful involvement by the Justice Department in key decisions affecting the scope and approach taken in special investigations and (2) the referral to Justice of suspected criminal violations; give adequate priority to pricing audits and commit enough audit staff to ensure the quality of individual audits and the adequacy of overall audit coverage, and develop a specific plan for promptly resolving all regulatory issues with particular attention to ensuring the resolution of those issues impeding enforcement audits and investigative efforts. The Attorney General should review opportunities to expand informal coordination channels to include regional level discussions of cases before formal referral of the case to him.

52562 (LA-UR—79-1817) **Studies of offshore petroleum leases using a cartoraphic data base system.** Sibert, J.L. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 9p. (CONF-790739—3). P 02/MF A01.

From Harvard computer graphics week '79; Cambridge, MA, USA (15 Jul 1979).

An innovative system combining techniques of computer graphics and data base management has been developed at the Los Alamos Scientific Laboratory for the United States Geological Survey (USGS). The system is based on a CODASYL-type network data base management system. An interactive query language has been developed to allow standard data base retrievals as well as cartographic display of retrieval results. Map displays include both real-time display on a CRT terminal (such as a Tektronix 4014) and postprocessed full-color display on computer output microfilm. Since the system became operational early in 1978, it has been used in a number of ongoing studies for both the USGS and the Department of Energy (DOE). The primary application to date has been verification of the Lease, Production, and Revenue data (LPR) amassed by the USGS as part of its regulatory responsibility. Over 150 color-coded maps of offshore areas in the Gulf of Mexico have been produced for comparison with hand-drawn originals. This has proved to be an effective verification procedure, because differences between the maps are readily visible. Other current applications include provisions of both data and displays for statistical studies of bidding behavior of oil companies for both USGS and DOE projects.

TRANSPORT, PIPELINES, AND HANDLING

52563 (FE—6434-T1) **Determination of functional and data requirements for pipeline information. Final report on Task No. 2.** (Ideamatics, Inc., Washington, DC (USA)). 16 Feb 1979. Contract EI-78-C-01-6434. 59p. P 04/MF A01.

This report describes the data needs of the DOE in the Pipeline area and how those needs are fulfilled by the information gathered on Form P. Chapter I provides an introduction to the methodology used in preparing the report, and background statements on Form P and on oil pipeline data. Chapter II defines the functional requirements of organizations/agencies which use pipeline information; Chapter III presents the data requirements for these same agencies; Chapter IV discusses publication requirements and formats for Form P data; and Chapter V summarizes conclusions and recommendations.

52564 (PNL—2421) **Energy material transport, now through 2000, system characteristics and potential problems. Task 3. Final report - petroleum transportation.** DeSteese, J.G. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Mar 1979. Contract EY-76-C-06-1830. 307p. P 14/MF A01.

This report contains a summary characterization of the petroleum transportation system and an assessment of some potential problems that may impact petroleum transportation in the United States during the balance of the century. A primary purpose of this task is to provide information and perspective that contribute to the evaluation of research and development needs and priorities in future programs. The system characterization in Section 3 includes a review of petroleum product movements, modal operations and comparisons, and transportation regulations and safety. This system overview summarizes domestic production and consumption scenarios to the year 2000. A median scenario based on published projections shows that the US will probably rely on foreign oil to supply between 40 and 50 percent of domestic petroleum needs throughout the balance of the century. Potential problems in petroleum transportation were identified by the analysis and prioritization of current issues. The relative priorities of problem concerns were judged on the basis of their overall impact on the system and the immediacy of this potential impact. Two classes of concern are distinguished: 1. Potential problems that appear to require new programmatic action, in addition to effort already committed, to minimize the possible future impact of these concerns. 2. Latent concerns that may increase or decrease in priority or entirely change in nature as they develop. While the trend of these concerns should be monitored, new program action does not appear necessary at this time.

52565 **Inert gas systems in shell tankers: metallurgical problems in operation.** Levens, M. *Mar. Eng. Rev.;* **37**: v(Oct 1977).

Corrosion problems in inert-gas systems (designed to prevent explosions in oil tankers) are briefly reviewed and method of protection and treatment are indicated.

STORAGE

52566 (SAND—79-0595) **Structural analysis of Weeks Island Mine/petroleum repository.** Hilton, P.D.; Benzley, S.E.; Gubbels, M.H. (Sandia Labs., Albuquerque, NM (USA)). Aug 1979. Contract EY-76-C-04-0789. 34p. P 03/MF A01.

Finite element stress analysis procedures are employed to study several structural characteristics of the Weeks Island Salt Mine. The existing mine is being converted to a reservoir for oil storage and new salt mining beneath the reservoir is planned. The present analysis addresses the concern of appropriate separation between the oil repository and the proposed mining. Creep calculations for a two level mine configuration are performed to predict the long-term structural response of the combined proposed mine and oil repository system in terms of web thickness (vertical separation). Elastic—plastic analyses are used to study the influence of a postulated outburst (or blowout) during the new mining on overall structural response. The results indicate that the web thickness of 90m is conservatively sufficient for the support of the oil repository. Further, outbursts only influence the local stress field in the mine structure and do not substantially alter or reduce the mine's integrity. Thus the acceptable web thickness must be the larger of that required for structural integrity or that required to prevent direct communication of the mine levels by a large outburst. Appropriate safety factors are needed in either case.

52567 (SAND—79-1468) **Strategic petroleum reserve: an analysis of potential corrosion problems.** Douglass, D.L. (Sandia Labs., Albuquerque, NM (USA)). Jul 1979. Contract EY-76-C-04-0789. 27p. P 03/MF A01.

An analysis was made using first principles to ascertain the severity or likelihood of corrosion. Four major system components were identified and considered in detail: Interior Pipeline Corrosion

by Brine, Exterior Pipeline Corrosion by Surface Soil Water, Exterior Downhole Casing Corrosion, and Galvanic Corrosion.

NATURAL GAS

REFER ALSO TO CITATION(S) 53325

RESERVES

52568 (DOE/EIA—0167) **Gas supplies of interstate natural gas pipeline companies; 1977.** Pappas, T.A. (Department of Energy, Washington, DC (USA). Energy Information Administration). Jun 1979. 135p. P 07/MF A01.

This report provides a statistical summary of the year-end 1977 total reserves and deliverability of the interstate pipeline companies and pertinent comparisons with information developed from Form 15 annual reports filed over the preceding 14 years. Total dedicated domestic gas reserves owned and controlled by interstate pipeline companies declined in 1977 by 5.4 trillion cubic feet, or 5.5%, from 98.3 trillion cubic feet at the beginning of the year to 92.9 trillion cubic feet at the end of the year. A five-year tabulation shows that domestic interstate gas reserves have declined from 146.9 trillion cubic feet at the beginning of 1973 to 92.9 trillion cubic feet at the end of 1977, a decline of 54.0 trillion cubic feet, or 36.8%. The reported peak of 198.1 trillion cubic feet was at year-end 1967. Total net revisions to interstate gas reserves during 1977 are calculated at approximately minus 253 billion cubic feet. For 1976 the total net revisions were calculated to be a minus 1.2 trillion cubic feet.

GEOLOGY AND EXPLORATION

REFER ALSO TO CITATION(S) 52535, 52536, 52537, 52583

52569 (METC/EGSP—11) **Gas show and production map from Middle and Upper Devonian organic rich shales in western and northern Pennsylvania.** Piotrowski, R.G.; Krajewski, S.A. (Pennsylvania Dept. of Environmental Resources, Harrisburg (USA). Bureau of Topographic and Geologic Survey). 1979. Contract EY-76-S-05-5198. 45p. P 03/MF A01.

52570 (ORO—5202-T3) **Black shale studies in Kentucky. Quarterly report, April-June 1979.** (Kentucky Geological Survey, Lexington (USA). Dept. of Geology). 1979. Contract EY-76-C-05-5202. 240p. P 11/MF A01.

The bulk of this document comprises a thesis by Gerald Markowitz, which is a geochemical study of the Upper Devonian-Lower Mississippian black shales in eastern Kentucky. (DLC)

52571 (ORO—5203-T1) **Geologic and geochemical studies of the New Albany Group (Devonian black shale) in Illinois to evaluate its characteristics as a source of hydrocarbons. Quarterly progress report, October 1-December 31, 1978.** Bergstrom, R.E.; Shimp, N.F. (Illinois State Geological Survey, Urbana (USA)). 1 Jan 1979. Contract EY-76-C-05-5203. 55p. P 04/MF A01.

This proect is a detailed analysis of the lithology, stratiraphy, and structure of the New Albany Group in Illinois to determine those characteristics of lithology, thickness, regional distribution, vertical andlateral variability, and deformation that are most relevant to the occurrence of hydrocarbons.

52572 (ORO—5205-11-1) **Characterization and analysis of Devonian shales as related to release of gaseous hydrocarbons. Well V-7 Wetzel County, West Virginia.** Kalyoncu, R.S.; Boyer, J.P.; Snyder, M.J. (Battelle Columbus Labs., OH (USA)). 15 Aug 1979. Contract EY-76-C-05-5205. 133p. P 07/MF A01.

This program was initiated in September 1976, with the objective and scope of determining the relationships between the shale characteristics, hydrocarbon gas contents, and well location, and thereby provide a sound basis for (1) assessing the productive capacity of the Eastern Devonian Gas Shale deposits, and (2) guiding research, development and demonstration projects to enhance the recovery of natural gas from the shale deposits. Included in the scope of the program are a number of elemental tasks as a part of the Resource Inventory and Shale Characterization subprojects of DOE's Eastern Gas Shales Project designed to provide large quantities of support data for current and possibly future needs of the Project.

52573 (ORO—5205-11-2) **Characterization and analysis of Devonian shales as related to release of gaseous hydrocarbons. Well K-4 Johnson County, Kentucky.** Kalyoncu, R.S.; Snyder, M.J. (Battelle Columbus Labs., OH (USA)). 15 Aug 1979. Contract EY-76-C-05-5205. 158p. P 08/MF A01.

Various characterization tasks were performed on 54 cored shale samples from Johnson County, Kentucky. Core samples were obtained from depths of 967 to 1510 feet. A total of 126 samples were canned for several DOE contractors, including Battelle Columbus. Free gas analyses indicate the presence of significant quantities of higher chain hydrocarbon gases in the K-4 shales. Hydrocarbon gas release rates and kinetic studies indicate that diffusion coefficients are inversely proportional to the square root of the molecular weight of diffusing species. Although wide scatter is observed in the chemical and physical characterization data, good correlations exist between the hydrocarbon gas contents and various laboratory characterization values (physical and chemical). A number of one-to-one relationships are pointed out and discussed. Lithologically, inorganic portions of K-4 shales are composed predominantly of quartz and illite with small quantities of pyrite and various carbonate minerals.

DRILLING, PRODUCTION, AND PROCESSING

REFER ALSO TO CITATION(S) 52569

52574 (ORO—5194-2(Vol.2)) **Analysis of the structural parameters that influence gas production from the Devonian shale. Annual progress report. Volume 2. Data repository and reports published during fiscal year 1977-1978.** Shumaker, R.C.; Negus de Wys, J.; Dixon, J.M. (West Virginia Univ., Morgantown (USA). Dept. of Geology and Geography). Oct 1978. Contract EY-76-C-05-5194. 237p. P 11/MF A01.

Six appendices are included in this report: regional structure data, surface structure data, surface fracture data, production data, hydrology data, and geophysical data. (DLC)

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 52575

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 53131, 53313, 53314, 53320, 53322, 53323, 53324

ENVIRONMENTAL EFFECTS

52575 (UCID—17968-78-2) **Liquefied Energy Fuels Spill Effects Program. Quarterly report, October-December 1978.** Hogan, W.J. (comp.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1979. Contract W-7405-ENG-48. 80p. P 05/MF A01.

The following articles are in this report: validity of desert site scale-effects experiments; comparison of dispersion models for spills of liquefied natural gas; a review of the 1978 China Lake natural gas dispersion experiments and instrumentation; and the spreading and differential boiloff for a spill of liquefied natural gas on a water surface.

52576 (UCRL—82441) **Simulation of LNG vapor spread and dispersion by finite element methods.** Chan, S.T.; Gresho, P.M.; Lee, R.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jul 1979. Contract W-7405-ENG-48. 34p. (CONF-790915—1). P 03/MF A01.

From National conference on numerical methods in heat transfer; College Park, MD, USA (24 Sep 1979).

Two finite element models (one based on solving the time-dependent, two-dimensional conservation equations of mass, momentum, and energy, with buoyancy effects included via the Boussinesq approximation; the other based on solving the otherwise identical set of equations except using the hydrostatic assumption) are described and applied to predict some aspects of the vapor dispersion phenomena associated with LNG spills. A number of controlled numerical experments, representing a reasonable expected range of LNG spill scenarios and atmospheric conditions, have been carried out. Based on comparing the results obtained with these finite element models, some data regarding the applicability and limitations of the hydrostatic assumption for predicting LNG vapor spread and dispersion are established.

ARTIFICIAL STIMULATION, PLOWSHARE, ETC.

REFER ALSO TO CITATION(S) 52544

52577 (DOE/BG/01569—8) **Western Gas Sands Project. Status report, 1 May 1979—31 May 1979.** (CER Corp., Las Vegas, NV (USA)). 1979. Contract AC08-79BG01569. 62p. P 04/MF A01.

May 1979 progress of the government-sponsored projects directed toward increasing gas production from low-permeability gas sands of the western United States is summarized in this edition of the WGSP status report. The September 1977 status report, NVO/0655-100, provides background information. Work by the USGS toward resource assessment in the four primary study areas continued. Projects of the National Laboratories and Energy Technology Centers continued during May. Bartlesville Energy Technology Center continued work on fracture conductivity, rock-fluid interaction, and log evaluation and interpretation techniques. Lawrence Livermore Laboratory continued experimental and theoretical work on hydraulic fracturing mechanics and analysis of well test data. Analysis of data obtained from a test of the borehole seismic unit by Sandia Laboratories is continuing. Preliminary design work began on a DOE-financed experimental multi-well fracturing project. Cyclic gas injection operations were begun by Colorado Interstate Gas Company on the Miller No. 1 well. The Mitchell Energy Corporation Muse-Duke No. 1 well flowed 3,500 MCFD in May. Fishing operations resumed on the Mobil PCU F31-13G well.

52578 (DOE/BG/01569—9) **Western Gas Sands Project quarterly basin activities report.** Atkinson, C.H. (CER Corp., Las Vegas, NV (USA)). 30 Apr 1979. Contract AC08-79BG01569. 46p. P 03/MF A01.

This quarterly basin activities report is a summation of three months drilling and testing activities in the Greater Green River Basin, Northern Great Plains Province, Piceance Basin, and Uinta Basin. Detailed information is given for each study area for the first quarter of 1979.

52579 (NVO—0655-10) **Western Gas Sands Project. Status report, 1 June—30 June 1979.** (CER Corp., Las Vegas, NV (USA)). 1979. Contract AC08-BG01569. 69p. P 04/MF A01.

This edition of the WGSP status report summarizes June 1979 progress of government-sponsored projects directed toward increasing gas production from the low-permeability gas sands of the western United States. Background information is provided in the September 1977, status report, NVO/0655-100. Work by the USGS toward resource assessment in the four primary study areas continued. CK GeoEnergy started a core hole in Grand County, Utah. During June, projects of the National Laboratories and Energy Technology Centers continued. Bartlesville Energy Technology Center continued work on fracture conductivity, rock-fluid interaction, and log evaluation and interpretation techniques. Experimental and theoretical work on hydraulic fracturing mechanics and analysis of well test data continued at Lawrence Livermore Laboratory. The CER Corporation RB-MHF 3 final report has been distributed. Cyclic gas injection began again on CIG's Sprague No. 1 well. The DOE well test facility was transported to Vernal, Utah for minor repairs and storage. The GPE wells, Natural Buttes Units 9, 14 and 18 flowed to sales. The Mitchell Energy Muse-Duke No. 1 well flowed 3,000 MCFD in June. Attempts to kill the Mobil PCU F31-13G well failed. Exploratory coring of the Sandia Hole No. 6 Formation Interface Fracture Experiment resumed in June.

52580 (UCRL—50036-79-1) **LLL Gas Stimulation Program. Quarterly progress report, January-March 1979.** Hanson, M.E.; Anderson, G.D.; Shaffer, R.J.; Towse, D.F.; Duba, A.G.; Burkhard, N.R.; Lin, W.; Cleary, M.P.; Haimson, B.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 May 1979. Contract W-7405-ENG-48. 28p. P 03/MF A01.

This report summarizes the reseach and accomplishments of the LLL Gas Stimulation Program during the second quarter of FY 1979. Two-dimensional dynamic models were used to analyze some aspects of dynamic fracture propagation near bonded interfaces. Theoretical models were also used to analyze aspects of a blunting process that occurs when a pressurized fracture contacts another fracture that lies at various angles to the created fracture. Friction coefficient measurements for Indiana limestone show 0.51 as an indicated mean value of the static frictional coefficient. Effects of viscosity of the fracturing fluid were experimentally determined under various principal stress states in a polyaxial stress cell. Some intial log analyses and comparisons with core for a well in the Piceance basin were also completed.

52581 **Teoriya vodonapornogo rezhima gazovykh mestorozhdenii. (Theory of the water-driven regime for gas deposits).** Zakirov, S.N.; Korotaev, Yu.P.; Kondrat, R.M.; Turniev, V.N.; Shmyglya, O.P. Moscow, USSR; Izdatel'stvo Nedra (1976). 240p.

Results are given for laboratory experiments on the mechanism of gas yield. Particular attention is given to entrapped gas in a bed's flooded zone. A method for gas hydrodynamic computations of stratial water entry into a bed was devised on the basis of completed experiments. Computer-performed calculations indicated the effect that various factors have on the characteristics of a water-driven regime. A study was made of the possible acceptance of various allowances during the computation of water entry into a bed. The integral correlations method was used to obtain a solution to the problem of unsteady water flow into an enlarged well as its yield varies. The obtained formulas have made it possible to propose a method of solving both direct and inverse problems of the theory of a water-drive regime. The solution of inverse problems (refinement of the bed's water-carrying parameters) employed information about the development of a gas bed as well as data on changes in the pressures in piezometric wells. An examination was made of problems associated with the interference of beds belonging to a unified stratial water-driven system. Computer-run mathematical experiments were performed, and experiments on electric models were carried out for the purpose of investigating the possible control of developing gas deposits both in a gas and water-driven regime. The presented theoretical problems are accompanied by calculations. 132 references, 90 figures, 43 tables.

TRANSPORT, PIPELINES, AND HANDLING

52582 **Avtomatizatsiya i telemekhanizatsiya gazovogo khozyaistva. (Automation and telemechanization of the gas industry).** Sladkov, S.P. Moscow, USSR; Atomizdat (1977). 293p.

A description is given of an arrangement of automation and remote control systems used in urban gas systems and in gas mains. A decription is given of instruments for measuring temperature, pressure, gas flow rate, and the determination of the basic characteristics of gas mixtures as well as instruments used in the automated control systems of gas equipment. An examination is made of the circuitry and arrangement of equipment used to protect gas lines from corrosion. The teaching aid is designed for students at tekhnikums who are specializing in gas system management.

STORAGE

REFER ALSO TO CITATION(S) 53324

OIL SHALES AND TAR SANDS

SITE GEOLOGY AND HYDROLOGY

SITE GEOLOGY

REFER ALSO TO CITATION(S) 52537, 52569, 52571, 52572, 52573, 52574

52583 (FE—2287-T8) **Characterization and resource appraisal of the Devonian black shales of the Appalachian Basin.** de Witt, W. Jr. (Geological Survey, Washington, DC (USA)). 1979. Contract EX-76-A-01-2287. 4p. P 02/MF A01.

The status of the program to characterize the dark-brown to black carbonaceous gas-productive and potentially gas-productive shales and associated rocks of middle and late Devonian age in the Appalachian basin using data developed from the stratigraphy, structure, geophysics, paleontology, geochemistry and hydrocarbon productivity of the strata is described briefly.

52584 (FE—2346-32) **X-ray mineralogy and physical properties of antrim shale samples from Sanilac Co., Michigan.** Hockings, W.A.; Ruotsala, A.P.; Bennett, G.W. (Michigan Technological Univ., Houghton (USA). Dept. of Geology and Geological Engineering). Mar 1979. Contract EX-76-C-01-2346. 53p. P 04/MF A01.

This report describes mineralogical determinations and physical properties of core samples from wells 100, 101, and 102 located on Dow Chemical Company property in Fremont Township, Sanilac County, Michigan. Mineralogical determinations were made by x-ray powder diffraction. Quantitative results were obtained by comparison with prepared standards. Physical properties measured include density, porosity, pore size distribution, permeability, and specific surface. These properties were measured on natural samples and on samples which had been roasted in nitrogen and in air. Weight and dimensional changes produced by roasting were also measured.

52585 (METC/EGSP—1) **Preliminary stratigraphic cross section (C1-C3) showing radioactive black shale zones and sandstones in the Middle and Upper Devonian, western Pennsylvania.** Piotrowski, R.G.; Krajewski, S.A. (Pennsylvania Dept. of Environmental Resources, Harrisburg (USA). Bureau of Topographic and Geologic Survey). 1979. Contract EY-76-S-05-5198. 50p. P 03/MF A01.

52586 (METC/EGSP—2) **Preliminary stratigraphic cross section (A3-D3) showing radioactive black shale zones and sandstones in the Middle and Upper Devonian, western Pennsylvania.** Piotrowski, R.G.; Krajewski, S.A. (Pennsylvania Dept. of Environmental Resources, Harrisburg (USA). Bureau of Topographic and Geologic Survey). 1979. Contract EY-76-S-05-5198. 40p. P 03/MF A01.

52587 (METC/EGSP—3) **Preliminary stratigraphic cross section (A2-D2) showing radioactive black shale zones and sandstones in the Middle and Upper Devonian, western Pennsylvania.** Piotrowski, R.G.; Krajewski, S.A. (Pennsylvania Dept. of Environmental Resources, Harrisburg (USA). Bureau of Topographic and Geologic Survey). 1979. Contract EY-76-S-05-5198. 40p. P 03/MF A01.

52588 (METC/EGSP—4) **Preliminary stratigraphic cross section (A1-D1) showing radioactive black shale zones and sandstones in the Middle and Upper Devonian, western Pennsylvania.** Piotrowski, R.G.; Krajewski, S.A. (Pennsylvania Dept. of Environmental Resources, Harrisburg (USA). Bureau of Topographic and Geologic Survey). 1979. Contract EY-76-S-05-5198. 40p. P 03/MF A01.

52589 (METC/EGSP—5) **Preliminary stratigraphic cross section (C4-D4) showing radioactive black shale zones and sandstones in the Middle and Upper Devonian, western Pennsylvania.** Piotrowski, R.G.; Krajewski, S.A. (Pennsylvania Dept. of Environmental Resources, Harrisburg (USA). Bureau of Topographic and Geologic Survey). 1979. Contract EY-76-S-05-5198. 55p. P 04/MF A01.

52590 (METC/EGSP—6) **Preliminary stratigraphic cross section (D3-D4) showing radioactive black shale zones and sandstones in the Middle and Upper Devonian, western Pennsylvania.** Piotrowski, R.G.; Krajewski, S.A. (Pennsylvania Dept. of Environmental Resources, Harrisburg (USA). Bureau of Topographic and Geologic Survey). 1979. Contract EY-76-S-05-5198. 50p. P 03/MF A01.

52591 (METC/EGSP—7) **Preliminary stratigraphic cross section (B1-B4) showing radioactive black shale zones and sandstones in the Middle and Upper Devonian, western Pennsylvania.** Piotrowski, R.G.; Krajewski, S.A. (Pennsylvania Dept. of Environmental Resources, Harrisburg (USA). Bureau of Topographic and Geologic Survey). 1979. Contract EY-76-S-05-5198. 45p. P 03/MF A01.

52592 (METC/EGSP—8) **Preliminary stratigraphic cross section (D1-D3) showing radioactive black shale zones and sandstones in the Middle and Upper Devonian, western Pennsylvania.** Piotrowski, R.G.; Krajewski, S.A. (Pennsylvania Dept. of Environmental Resources, Harrisburg (USA). Bureau of Topographic and Geologic Survey). 1979. Contract EY-76-S-05-5198. 38p. P 03/MF A01.

52593 (METC/EGSP—9) **Preliminary stratigraphic cross section (A1-A4) showing radioactive black shale zones and sandstones in the Middle and Upper Devonian, western Pennsylvania.** Piotrowski, R.G.; Krajewski, S.A. (Pennsylvania Dept. of Environmental Resources, Harrisburg (USA). Bureau of Topographic and Geologic Survey). 1979. Contract EY-76-S-05-5198. 40p. P 03/MF A01.

52594 (METC/EGSP—10) **Drilling depth map to the top of the Middle Devonian Onondaga Group.** Piotrowski, R.G.; Krajewski, S.A. (Pennsylvania Dept. of Environmental Resources, Harrisburg (USA). Bureau of Topographic and Geologic Survey). 1979. Contract EY-76-S-05-5198. 50p. P 03/MF A01.

52595 (METC/EGSP—14) **Structure contour map on top of the Middle Devonian Onondaga Group in western and northern Pennsylvania.** Harper, J.A.; Piotrowski, R.G. (Pennsylvania Dept. of Environmental Resources, Harrisburg (USA). Bureau of Topographic and Geologic Survey). 1979. Contract EY-76-S-05-5198. 48p. P 03/MF A01.

52596 (METC/EGSP—800) **Map showing structure on base of New Albany shale (Devonian and Mississippian) and equivalent strata in Indiana.** Bassett, J.L.; Hasenmueller, N.R. (Indiana State Dept. of Natural Resources, Indianapolis (USA). Geological Survey). 1979. Contract EY-76-C-05-5204. 12p. P 02/MF A01.

52597 (METC/EGSP—801) **Map showing structure on top of New Albany Shale (Devonian and Mississippian) and equivalent strata in Indiana.** Bassett, J.L.; Hasenmueller, N.R. (Indiana State Dept. of Natural Resources, Indianapolis (USA). Geological Survey). 1979. Contract EY-76-C-05-5204. 12p. P 02/MF A01.

52598 (ORO—5201-4) **Annual and fourth quarter report for 1977—1978.** Potter, P.E.; Maynard, J.B.; Pryor, W.A. (Cincinnati Univ., OH (USA)). 1 Oct 1978. Contract EY-76-C-05-5201. 27p. P 03/MF A01.

Studies of shales in the Appalachian area are reported (mainly in the form of abstracts of reports or manuscripts). They discuss the geology, lithology, stratigraphy, radioactivity, organic matter, the isotopic abundance of carbon and sulfur isotopes, etc. of shales in this area with maps. One report discusses Devonian paliocurrents in the central and northern Appalachian basin. Another discusses sedimentology of the Brallier Formation. The stratigraphy of upper Devonian shales along the southern shore of Lake Erie was also studied. (LTN)

OIL PRODUCTION, RECOVERY, AND REFINING

REFER ALSO TO CITATION(S) 52531, 52608

IN SITU METHODS, TRUE AND MODIFIED

52599 (FE—1747-3) **BX In Situ Oil Shale Project. Quarterly technical progress report, September 1—November 30, 1977.** Duncan, P.M. (Equity Oil Co., Salt Lake City, UT (USA)). 15 Dec 1977. Contract ET-78-F-03-1747. 33p. P 03/MF A01.

Work focused on the tasks related to laboratory experimentation; project reactivation; mathematical modeling; design and installation of the instrumentation system; project design and construction; and environmental monitoring. Specific activities related to each of these principal task areas are reported.

52600 (FE—1747-5) **BX In Situ Oil Shale Project. Quarterly technical progress report, March 1—May 31, 1978.** Duncan, P.M. (Equity Oil Co., Salt Lake City, UT (USA)). 20 Jun 1978. Contract ET-78-F-03-1747. 41p. P 03/MF A01.

Work on the BX In Situ Oil Shale Project consisted of finalization of design for instrumentation, well spacing, and equipment layout; the beginning of the drilling of injection and production wells; and the finalization of a contract with Stearns Roger Corporation to provide operating personnel for the project.

52601 (FE—2346-44) **Energy from in situ processing of Antrim oil shale. Quarterly technical progress report, January—March 1979.** Washington, L.J. Jr. (Dow Chemical Co., Midland, MI (USA). Hydrocarbons and Energy Research Dept.). 20 Mar 1979. Contract EX-76-C-01-2346. 45p. (DOW/SRPR—44). P 03/MF A01.

Permeability studies on the 100 series wells, which had been hydraulically and then explosively fractured, have shown much greater communication between wells and much greater permeability than had been present in the wells on the existing site during the 1978 extraction trials. Well No. 301, which is the central well in the explosive underreaming series, was cleaned out. Two wells were drilled and cored nearby. Extensive fracturing due to the use of explosives in Well No. 301 was evident in the well located 15 feet from the site of the explosive treatment. Communication between these wells is also evident. A downhole methane burner of Tejas Petroleum Engineers was successfully tested under realistic operating conditions in an existing well. Other preparations for the planned extraction trial are continuing.

52602 (SAND—79-1188) **Oil Shale Programs. Thirteenth quarterly report, January 1979-March 1979.** Stevens, A.L. (ed.). (Sandia Labs., Albuquerque, NM (USA)). Jul 1979. Contract EY-76-C-04-0789. 46p. P 03/MF A01.

Three programs are reported: diagnostics and rock mechanics support for the Laramie In-Situ Oil Shale Program, advanced instrumentation and field projects for in-situ oil shale processing, and in-situ bed preparation study. (DLC)

52603 (TID—28956) **Oil shale in situ research and development. Quarterly report No. 2, November 1, 1977-January 31, 1978.** Graf, G.L. (Talley-Frac Corp., Mesa, AZ (USA)). 1978. Contract ET-77-C-03-1791. 107p. P 06/MF A01.

This program pertains to the Oil Shale Site 12 near Green River, Wyoming. The report includes a narrative report on the in-situ R and D program and on engineering progress on fracture and retort design and evaluation, a survey of the Section 17 in Sweetwater County, an outline of hydrogeological plan, various meetings, proposed hydraulic fracturing program, well logs, work plan and schedule. (DLC)

52604 (UCRL—82077) **LLL progress toward process control of commercial modified in-situ retort operations for high yield.** Galloway, T.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Jul 1979. Contract W-7405-ENG-48. 15p. (CONF-790440—5). P 02/MF A01.

From 12. oil shale symposium; Golden, CO, USA (18 Apr 1979).

Recent results from experiments on the LLL 1/8-and 6-Mg pilot-scale oil-shale retorts have provided new insight into the key oil-loss mechanisms and have suggested a number of practical process-control means for maximizing in situ retort yields. Steam or water mist, total flow, and oxygen flux are valuable process handles in controlling the maximum bed temperatures below 950°C. Shale beds containing a broad size range (i.e., 30-cm to 10--m particles) were found to retort with lower yields than beds with smaller particles in narrow size ranges. The lower yield is dominated by the

larger shale blocks through coking and cracking within the block and oxidation and cracking of the oil vapor released outside the block. The oxidation loss results from nonuniform flow that lets oxygen penetrate into the retorting zone. Oxidation and cracking outside blocks appeared to be the dominant loss mechanisms. These may possible be controlled by adding steam, water mist, or recycled exhaust gases to the input air. Process control concepts such as stepwise inert-gas injection and thermal-conduction calming are also discussed. Amont the process indicators considered are low-molecular-weight gases, alkene/alkane ratios, and the roughness (i.e., peaks) of the retorting or steam front. 15 figures.

PROPERTIES AND COMPOSITION

REFER ALSO TO CITATION(S) 52570

52605 (MLM—2640) **Material balance assay of Devonian gas shale.** Kapsch, D.M.; Frye, J.O.; Nunn, E.B. (Mound Facility, Miamisburg, OH (USA)). 20 Aug 1979. Contract EY-76-C-04-0053. 20p. P 02/MF A01.

A Devonian shale retorting method, similar to the TOSCO Material Balance Assay, was developed. Oil, gas, water, and spent shale collected from the thermal decomposition of Devonian shale provide material balance closure. Elemental and other analyses were used to characterize the products and evaluate their fuel potential. The precision of each analysis was estimated by running a series of material balance assays on a composite shale sample. The elemental composition of this shale oil was shown to remain unchanged on aging. Typical material balance assays from each well where core samples were taken are presented.

52606 **Reaction kinetics between CO;sub 2; and oil-shale residual carbon--1. effect of heating rate on reactivity.** Burnham, A.K. (Univ of Calif, Lawrence Livermore Lab). *Fuel;* **58**: No. 4, 285-292(Apr 1979).

In this paper, the first part of an investigation of the reactivity of oil-shale residual carbon is reported. The reaction kinetics of CO;sub 2; with oil-shale residual carbon were measured using both isothermal and nonisothermal methods. The effect of the heating rate in the retort on the subsequent reactivity of the residual carbon was examined. Surface area and mercury porosimetry results are presented in an attempt to explain this difference in reactivity.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 52531, 53728, 53729, 53748

52607 (BNL—51002, pp 97-105) **LASL industrial hygiene experiences in the oil shale industry.** Garcia, L.L. (Los Alamos Scientific Lab., NM). Mar 1979.

From Symposium on assessing the industrial hygiene monitoring needs for the coal conversion and oil shale industries; Upton, NY, USA (5 Nov 1978).

Various facets of the Paraho Process are discussed. An industrial hygiene survey of the facilities for retorting oil by the Paraho Process at Anvil Points was planned but not completed. Suggestions for future surveys are made. (JGB)

ENVIROMENTAL ASPECTS

REFER ALSO TO CITATION(S) 53735, 53743

52608 (BNL—51002, pp 41-60) **Oil shale: process description and effluent characterization.** Coomes, R.M. (Tosco Corp., Los Angeles, CA). Mar 1979.

From Symposium on assessing the industrial hygiene monitoring needs for the coal conversion and oil shale industries; Upton, NY, USA (5 Nov 1978).

Various methods of processing oil shales are described. The possibility of potential exposure of workers to vapors, dusts or mists is described. Colony has been concerned with the potential health effects of oil shale processing, and contracted our first health-related studies to outside laboratories in 1965. Since that time, over $500,000 has been invested in chemical characterization and biological testing of oil shale materials. We have tested raw oil shale, TOSCO II processed shale, crude shale oil, hydrotreated shale oil, and TOSCO II atmospheric effluent for their toxicity and carcinogenicity. It is concluded from these experimental results that crude shale oil presents a carcinogenic hazard similar to or less than that of currently used petroleum products, that hydrotreating dramatically reduces this carcinogenicity, and that solid oil shale materials do not present a carcinogenic hazard.

52609 (UCRL—82455) **Preparation and injection of grout from spent shale for stabilization of abandoned in-situ oil shale retorts.** Mallon, R.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Jun 1979. Contract W-7405-ENG-48. 11p. (CONF-790913—6). P 02/MF A01.

From 54. annual technical conference and exhibition; Las Vegas, NV, USA (23 Sep 1979).

A procedure has been developed for stabilizing abandoned in-situ oil shale retorts by means of high-temperature treatment of surface-processed shale, followed by grinding, mixing with water, and injection underground. Laboratory results indicate that abandoned in-situ retorts can be made strong enough to prevent subsidence, and sufficiently impermeable to greatly reduce groundwater flow. The underground injection also reduces the amount of spent shale disposal on the surface.

REGULATIONS

52610 (DOE/ET/83764—1) **Development and application of a Permit Information System for Shale Oil (PERMISSO). Final report June 1978—May 1979.** (Science Applications, Inc., Golden, CO (USA)). Jul 1979. Contract W-31-109-ENG-38. 116p. P 06/MF A01

This report covers the first phase of a program to develop a information system capable of describing and assessing the federal state, and county permitting process for oil shale development. It was found that the permitting system is in a constant state of change and is growing in complexity. There are potential direct savings of several millions of dollars in the development and use of an automated permitting system data base. (DLC)

52611 (DOE/ET/83764—1(App.)) **Development and application of a permit information system for shale oil (PERMISSO). Final report appendix: summary sheets of regulations required for oil shale development, June 1978—May 1979.** (Science Applications, Inc Golden, CO (USA)). Jul 1979. Contract W-31-109-ENG-38. 485p. 21/MF A01.

This appendix is comprised of summaries of various governmental permits, licenses and other approvals required for oil shale development. The summaries were completed during the period June—October 1978, and are current as of July 1, 1978, although more recent authority was cited in some cases. One of the major purposes of Phase II of the project will be to update these summaries as statutes and regulations are added, changed or eliminated. The updating will be particularly important in the case of environmental permits and approvals. Many legislative and regulatory changes affecting environmental requirements are pending at this time and will alter many of the summaries herein. In addition, many regulatory proposals have been or likely will be challenged in the courts. When such conflicts are resolved further changes may be in order.

NUCLEAR FUELS

REFER ALSO TO CITATION(S) 52644

52612 (ANL—79-60) **Nondestructive assay system for use in decommissioning a plutonium-handling facility.** Roche, C.T.; Vronich, J.J.; Bellinger, F.O.; Perry, R.B. (Argonne National Lab., IL (USA)). Jul 1979. Contract W-31-109-ENG-38. 30p. P 03/MF A01.

Argonne National Laboratory is decommissioning a facility used to fabricate reactor fuel elements. The equipment is contaminated with alpha emitters at levels up to 10^{12} dpm/100 cm^2. The objective of decontamination is to reduce the TRU concentrations below 10 nCi/g of waste. A portable NDA procedure using NaI(T1) gamma-spectrometric techniques was selected to measure the residual Pu and ^{241}Am in the glove boxes. Assays were performed at different stages in the decontamination process to estimate the detection system sensitivity and the effectiveness of the cleaning efforts.

RESERVES

52613 (LA-tr—78-75) **Geochemical stability of reactors: compilation of facts on remobilizations of uranium and rare earths.** Naudet, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). 1978. Translation of IAEA-TC—119/25. (CONF-771222—19(Trans)). 47p. P 03/MF A01.

From IAEA symposium on natural fission reactors; Paris, France (19 Dec 1977).

In spite of the very remarkable stability which has been shown for uranium and rare earths in the interior of the reaction zones, there have been partial remobilizations. As for uranium, the small isotope anomalies of the edge are the effect, it seems, of the

overlapping of several phenomena. The most important dates from the period of the reactions and must be attributed to convection currents moved by the releases of heat. In the period just before the present, a small fraction of the uranium of the edges was restructured into coffinite. As for the rare earths, remobilization is systematic and affects natural elements as well as fission products. It is also linked to the existence of convection currents at the time of the reactions, but it is completely unconnected with the existence of uranium. Except for Ce and Eu, a fraction of which was eliminated in the reaction zones, most are erratic short displacements on the order of a few decimeters, the effects of which were to slightly flatten the distributions and cause isotopic mixtures. The proportion of fission products carried outside the reactors is only a few percent, but contamination can still be detected several meters from the core. The migrating rare earths left the uranium either through the recoil effect, or during the reformation of pitchblende into uraninite, or through resolubilization of the uranium. They reentered the grains of uranium after recrystallization of the clays. This remobilization was accompanied by rather significant fractionation between the elements. In particular, the heavy rare earths (Gd, Dy) migrated in greater quantity and over longer distances than the light rare earths (Nd, Sm). The geochemical stability of the natural reactors, with its limits, is a fundamental problem, closely related to the problem of geochronology. The data on the remobilization of uranium and rare earths are complex and come from different sources.

EXPLORATION

52614 (GJBX—100(79)) **High resolution seismic study in the Gas Hills uranium district, Wyoming.** Applegate, J.K.; Donaldson, P.R.; Neitzel, E.B. (Boise State Univ., ID (USA). Dept. of Geology and Geophysics; Geophysical Service, Inc., Dallas, TX (USA)). 1979. Contract EY-76-C-13-1664. 102p. P 06/MF A01.

Objective of the study was to use sonic and density logs and compute synthetic seismograms to evaluate the feasibility of predicting the success of the seismic reflection technique, and test this prediction using surface seismic methods. The field study was undertaken utilizing primarily two energy sources -- a high frequency vibrator (40 to 350 Hz), and one-pound dynamite charges shot in ten-foot holes. A limited amount of data was also acquired utilizing detonating cord on the surface. Some 3-D data was also acquired, and a later study acquired passive seismic data. The seismic reflection data were clearly successful not only in delineating the unconformable surface and mapping paleo-drainages on the unconformity, but also in defining channel deposits within the Tertiary section. Correlation with the logs clearly shows the success of the study. Several areas were delineated where one would undertake tight drilling patterns, and other areas delineated in which one might minimize or eliminate drilling. The synthetic seismograms could also have predicted the success of the seismic work. In conclusion, the study indicates that in a geological environment such as the Gas Hills uranium district, the high resolution seismic reflection technique offers a cost-effective approach to minimizing the total number of drill holes, and in favorably locating those that are drilled.

52615 (GJBX—101(79)) **Engineering report on the drilling in the East Chaco Canyon of New Mexico.** (Bendix Field Engineering Corp., Grand Junction, CO (USA)). Jul 1979. Contract EY-76-C-13-1664. 50p. P 03/MF A01.

Th East Chaco Canyon drilling project was conducted in support of the National Uranium Resource Evaluation (NURE) program. This project consisted of 15 drill holes ranging in depth from 4,248 to 5,130 feet. A total of 70,421 feet were drilled, of which 4,933 feet were cored. Objective of the project was to test the uranium potential of the Morrison Formation (Jurassic) in an area where the Westwater Canyon Member contains thick sandstone units and where industry was unlikely to drill in the near future. This report presents individual borehole histories of the 15 holes.

52616 (GJBX—103(79)) **Engineering report on the drilling in the Spor Mountain area of Utah.** (Bendix Field Engineering Corp., Grand Junction, CO (USA)). Jul 1979. Contract EY-76-C-13-1664. 113p. P 06/MF A01.

The Spor Mountain Drilling Project was conducted by Bendix Field Engineering Corporation in support of the United States Department of Energy (DOE) National Uranium Resource Evaluation (NURE) program. This project consisted of 30 drill holes, ranging in depth from 372 feet (113.39 m) to 2,525 feet (769.62 m). A total of 33,143 feet (10,101.99 m) were drilled, of which 11,579 feet (3,529.28 m) were cored. The objective of the project was to test the continuity of uranium bearing host rocks, including the Beryllium Tuff and Yellow Chief sandstones, in several geologically favorable areas of the Thomas Range. This project began June 22, 1978, and continued through May 1979 with final site restoration and cleanup.

52617 (GJBX—106(79)(Vol.2)) **Airborne gamma-ray spectrometer and magnetometer survey: Ashton Quadrangle (Idaho, Montana, Wyoming). Final report.** (Western Geophysical Co. of America, Houston, TX. Aero Service Div.). May 1979. Contract EY-76-C-13-1664. 131p. P 07/MF A01.

Flight line profile data and statistical analysis results from the airborne gamma-ray spectrometer and magnetometer survey of the Ashton Quadrangle in Idaho, Montana, and Wyoming are presented.

52618 (GJBX—115(79)(Vol.1)) **Aerial radiometric and magnetic survey: Little Rock National Topographic Map, Arkansas.** (Geodata International, Inc., Dallas, TX (USA)). 1979. Contract EY-76-C-13-1664. 182p. Dep. NTIS, PC E13/MF E13.

The results of analyses of the airborne gamma radiation and total magnetic field survey flown for the region identified as the Little Rock National Topographic Map NI-15-5 are presented in Volumes I and II of this report. The airborne data gathered are reduced by ground computer facilities to yield profile plots of the basic uranium, thorium and potassium equivalent gamma radiation intensities, ratios of these intensities, aircraft altitude above the earth's surface, total gamma ray and earth's magnetic field intensity, correlated as a function of geologic units. The distribution of data within each geologic unit, for all surveyed map lines and tie lines, has been calculated and is included. Two sets of profiled data for each line are included with one set displaying the above-cited data. The second set includes only flight line magnetic field, temperature, pressure, altitude data plus magnetic field data as measured at a base station. A general description of the area, including descriptions of the various geologic units and the corresponding airborne data, is included also.

52619 (GJBX—116(79)(Vol.1)) **Aerial gamma ray and magnetic survey: Raton Basin Project. The Shiprock and Gallup Quadrangles of Arizona/New Mexico and Albuquerque Quadrangle, New Mexico. Final report.** (GeoMetrics, Inc., Sunnyvale, CA (USA)). Jun 1979. Contract EY-76-C-13-1664. 74p. Dep. NTIS, PC E08/MF E08.

From October 26 to December 1, 1978, geoMetrics, Inc., collected 9576 line miles of high sensitivity airborne radiometric and magnetic data in New Mexico and Arizona within three 1^0 x 2^0 NTMS quadrangles (Albuquerque, Gallup and Shiprock). These maps represent one half of the Raton Basin Project. All radiometric and magnetic data were fully reduced and interpreted by geoMetrics, and are presented as 4 volumes (one Volume I and 3 Volume II's) in this report. These three quadrangles lie primarily within the Colorado Plateau Physiographic Province. The San Juan Basin is the dominant geologic structure, occupying one third of the survey area. It is bordered by: the Defiance, Zuni, and Nacimiento Uplifts; Black Mesa Basin; and Rio Grande Rift. Two large Tertiary volcanic fields lie in the southeast. Major faulting occurs in the Rio Grande Rift and on the boundaries of the uplifts. The majority of exposed rocks are non-marine sediments of Mesozoic age. Major uranium ore deposits occur in Mesozoic rocks within the Grants Mineral Belt (Ambrosia Lake, Laguna, Gallup, and Shiprock Districts) and Monument Valley. Scattered minor occurrences of uranium are found in Phanerozoic and Precambrian rocks throughout the area. A total of 358 groups of statistically anomalous samples (Albuquerque, 99; Gallup, 129; Shiprock, 130) meet the criteria for valid anomalies and are discussed in the individual interpretation sections. Although a portion of the anomalies are clearly related to known uranium mines and milling operations, most lie in geologic units known either to (1) contain only minor deposits or, (2) contain no uranium deposits at all.

52620 (GJBX—117(79)(Vol.1)) **Aerial radiometric and magnetic survey: Price National Topographic Map, Utah.** (Geodata International, Inc., Dallas, TX (USA)). 25 May 1979. Contract EY-76-C-13-1664. 233p. Dep. NTIS, PC E12/MF E12.

The results of analyses of the airborne gamma radiation and total magnetic field survey flown for the region identified as the Price National Topographic Map NJ12-2 are presented in Volume I and II of this report. The airborne data gathered are reduced by ground computer facilities to yield profile plots of the basic uranium, thorium and potassium equivalent gamma radiation intensities, ratios of these intensities, aircraft altitude above the earth's surface, total gamma ray and earth's magnetic field intensity, correlated as a function of geologic units. The distribution of data within each geologic unit, for all surveyed map lines and tie lines, has been calculated and is included. Two sets of profiled data for each line are included with one set displaying the above-cited data. The second set includes only flight line magnetic field, temperature, pressure, altitude data plus magnetic field data as measured at a base station. A general description of the area, including descriptions of the various geologic units and the corresponding airborne data, is included also.

52621 (GJBX—118(79)(Vol.1)) **Aerial radiometric and magnetic survey: Tooele National Topographic Map, Utah.** (Geodata International, Inc., Dallas, TX (USA)). Jun 1979. Contract EY-76-C-13-1664. 196p. Dep. NTIS, PC E12/MF E12.

The results of analyses of the airborne gamma radiation and total magnetic field survey flown for the region identified as the Tooele National Topographic Map NK-12-10 are presented in Volumes I and II of this report. The airborne data gathered are reduced by ground computer facilities to yield profile plots of the basic uranium, thorium and potassium equivalent gamma radiation intensities, ratios of these intensities, aircraft altitude above the earth's surface, total gamma ray and earth's magnetic field intensity, correlated as a function of geologic units. The distribution of data within each geologic unit, for all surveyed map lines and tie lines, has been calculated and is included. Two sets of profiled data for each line are included with one set displaying the above-cited data. The second set includes only flight line magnetic field, temperature, pressure, altitude data plus magnetic field data as measured at a base station. A general description of the area, including descriptions of the various geologic units and the corresponding airborne data, is included also.

52622 (GJBX—119(79)(Vol.1)) **Aerial radiometric and magnetic survey: Hamilton National Topographic Map, Idaho and Montana.** (Geodata International, Inc., Dallas, TX (USA)). 1979. Contract EY-76-C-13-1664. 163p. Dep. NTIS, PC E10/MF E10.

The results of analyses of the airborne gamma radiation and total magnetic field survey flown for the region identified as the Hamilton National Topographic Map NL11-6 are presented in Volumes I and II of this report. The airborne data gathered are reduced by ground computer facilities to yield profile plots of the basic uranium, thorium and potassium equivalent gamma radiation intensities, ratios of these intensities, aircraft altitude above the earth's surface, total gamma ray and earth's magnetic field intensity, correlated as a function of geologic units. The distribution of data within each geologic unit, for all surveyed map lines and tie lines, has been calculated and is included. Two sets of profiled data for each line are included with one set displaying the above-cited data. The second set includes only flight line magnetic field, temperature, pressure, altitude data plus magnetic field data as measured at a base station. A general description of the area, including descriptions of the various geologic units and the corresponding airborne data, is included also.

52623 (GJBX—120(79)) **Hydrogeochemical and stream sediment reconnaissance basic data for New Ulm NTMS Quadrangle, Minnesota.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 29 Jun 1979. Contract W-7405-ENG-26. 250p. (K/UR—126). P 11/MF A01.

Results of a reconnaissance geochemical survey of the New Ulm Quadrangle, Minnesota are reported. Field and laboratory data are presented for 738 groundwater and 673 stream sediment samples. Statistical and areal distributions of uranium and possible uranium-related variables are displayed. A generalized geologic map of the survey area is provided, and pertinent geologic factors which may be of significance in evaluating the potential for uranium mineralization are briefly discussed. The groundwater data indicate high uranium concentrations are associated with high specific conductance, calcium, and sulfate values in groundwaters from the southwestern corner of the quadrangle where the Sioux Quartzite and Quaternary deposits are the producing horizons. Other groundwaters with high uranium concentrations are produced from granites in Renville and Redwood Counties and from the Sioux Quartzite in northwestern Brown County. The sediment data indicate that the distribution of uranium and associated variables is a function of the mineralogy, the source material for the glacial deposits, and the reworking of those and local materials by postglacial hydrologic processes. The northwest-northcentral region of the quadrangle appear to contain most of the sediments with high uranium values.

52624 (GJBX—122(79)) **Hydrogeochemical and stream sediment reconnaissance basic data report for the Prescott NTMS Quadrangle, Arizona.** Clark, R.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). May 1979. Contract W-7405-ENG-48. 152p. (UCRL—52696). Z , E05/MF E05.

Wet and dry sediment samples were collected throughout the 18,770-km^2 arid-to-semiarid area and water samples at available streams, springs, and wells. Neutron activation analyses of uranium and trace elements as well as other measurements made in the field and laboratory are presented in tabular hardcopy and microfiche format. The report includes six full-size overlays for use with the Prescott NTMS Quadrangle (1:250,000). Water sampling sites, water-sample uranium concentrations, water-sample conductivity, sediment sampling sites, and sediment-sample total uranium and thorium concentrations are shown on separate overlays. We present general and structural descriptions of the area and delineate the known uranium occurrences in this quadrangle. Most of the high uranium concentrations were associated with Cenozoic and Precambrian rocks. The highest were associated with Precambrian vein deposits located in the transition zone between the Colorado Plateau and the Basin and Range provinces.

52625 (GJBX—123(79)) **Uranium hydrogeochemical and stream sediment reconnaissance of the McGrath and Talkeetna NTMS Quadrangles, Alaska, including concentrations of forty-three additional elements.** Aamodt, P.L.; Jacobsen, S.I.; Hill, D.E. (Los Alamos Scientific Lab., NM (USA)). Apr 1979. Contract W-7405-ENG-36. 414p. (LA—7350-MS). P 18/MF A01.

During the summer of 1977, 1268 water and 1206 sediment samples were collected from 1292 lakes and streams throughout the two quadrangles in south-central Alaska. Each of the water samples was analyzed for uranium and 12 other elements and each of the sediment samples for uranium, thorium, and 41 other elements. Uranium concentrations in water samples range from below 0.02 ppB to 19.64 ppB. In general, lake waters contain somewhat less uranium than stream waters, and the highest concentrations in both sample types were found in or near the Alaska Range. Uranium concentrations in sediment samples range from 0.10 ppM to 172.40 ppM. The highest concentrations are found in samples collected in the Alaska Range near areas of felsic igneous rocks. Sediment samples having high thorium concentrations also come from areas underlain by felsic igneous rocks in the Alaska Range. The following areas were found to be most favorable for significant uranium mineralization: (1) the Windy Fork stock on the southeastern boundary of the McGrath quadrangle; (2) an area in the northwest corner of the Talkeetna quadrangle near the Mespelt prospects; (3) the Hidden River drainage in the northeast corner of the Talkeetna quadrangle; (4) an area near Chelatna Lake in the center of the Talkeetna quadrangle; (5) the Kichatna River drainage, near the western border of the Talkeetna quadrangle; and (6) an area near the Mount Estelle pluton in the extreme southwest corner of the Talkeetna quadrangle.

52626 (GJBX—124(79)(Vol.2)) **Aerial radiometric and magnetic survey: Brigham City National Topographic Map, Utah.** (Geodata International, Inc., Dallas, TX (USA)). 1979. Contract EY-76-C-13-1664. 126p. P 07/MF A01.

Volume 2 presents the flight line profile data and statistical anlysis results from the radiometric and magnetic survey of the Brigham City Quadrangle of Utah.

52627 (GJBX—126(79)(Vol.2H)) **Aerial radiometric and magnetic reconnaissance survey of portions of Arizona, Idaho, Montana, New Mexico, South Dakota and Washington. Volume 2-H. Pocatello Quadrangle. Final report.** (Texas Instruments, Inc., Dallas (USA)). May 1979. Contract EY-76-C-13-1664. 492p. PC E10/MF E10.

The results of a high-sensitivity, aerial, gamma-ray spectrometer and magnetometer survey of the Pocatello Quadrangle, Idaho, are presented. Instrumentation and methods are described in Volume 1 of this final report. This work was done by Texas Instruments Incorporated under Bendix Field Engineering Corporation Subcontract No. 78-184-L as part of the US Department of Energy National Uranium Resource Evaluation (NURE) Program. Statistical and geological analysis of the radiometric data revealed 67 uranium anomalies worthy of field-checking as possible prospects. Several units of unknown age have registered four significant anomalies associated with quartzites and gneisses. Precambrian, Cambrian, and Ordovician units in the area contain anomalies that may be indicative of uranium mineralization. Both quartzites and limestones may have good potential for hosting uranium deposits. Uranium prospects may be found at six localities containing Precambrian rocks, four areas with Cambrian rocks, and four sites with Ordovician rocks. There are 18 significant anomalies in Upper Paleozoic rocks that indicate the possible presence of uranium mineralization. These rocks are mainly limestone and sandstone. Twelve anomalies in Tertiary units are mainly associated with felsic volcanics or tuffaceous sediments. These rocks may act as hosts or source rocks for uranium mineralization. There are 82 first-priority anomalies in Quaternary units; however, 18 of these may be due to sandstone interbeds in basalts, and 43 are attributable to uranium-rich fill on roads and railroads. Also, many of the anomalies in the Quaternary may be caused by uranium-rich source rocks rather than uranium mineralization.

52628 (GJBX—126(79)(Vol.2I)) **Aerial radiometric and magnetic reconnaissance survey of portions of Arizona, Idaho, Montana, New Mexico, South Dakota and Washington. Volume 2-I. Twin Falls Quadrangle. Final report.** (Texas Instruments, Inc., Dallas (USA)). 1979. Contract EY-76-C-13-1664. 330p. PC E08/MF E08.

The results of a high-sensitivity, aerial, gamma-ray spectrometer and magnetometer survey of the Twin Falls Quadrangle, Idaho, are presented. Instrumentation and methods are described in Volume 1 of this final report. This work was done by Texas Instruments Incorporated under Bendix Field Engineering Corporation Subcontract No. 78-184-L as part of the US Department of Energy National Uranium Resource Evaluation (NURE) Program. Statistical and geological analysis of the radiometric data revealed 21 uranium anomalies worthy of field-checking as possible prospects. The Tertiary Idavada volcanics show the greatest potential as possible source rocks for uranium. Eleven anomalies may be indicative of possible uranium prospects in this unit. Caution was exercised in the interpretation of anomalies in the Twin Falls Quadrangle; soils in this area contain a thin layer of uranium-rich volcanic ash, sandstone interbeds in basalts may cause anomalies, windows in the basalts may expose silicic volcanics, and nonstandard geometry over narrow canyons may give rise to apparent anomalies when altitude correc-

tions are applied. Therefore, only strong anomalies were considered significant. Six significant anomalies are associated with Quaternary or Tertiary basalts, one is related to Tertiary lake and stream deposits, and three pertain to Quaternary deposits.

52629 (LA—7907-PR) **Geostatistics project of the National Uranium Resources Evaluation Program. Progress report, October 1978—March 1979.** Beckman, R.J.; Bement, T.R.; Campbell, K.; Howell, J.S.; Wecksung, G.W.; Whitemann, D.E. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 27p. P 03/MF A01.

During the period covered by this report, research was concentrated on multivariate approaches to the analysis of aerial radiometric data. Two aspects of principal components analysis were the subjects of two publications. The procedures recommended for linear discriminant analysis were revised. Progress was made in overlaying LANDSAT data with aerial radiometric data from the Lubbock quadrangle. Some preliminary results from principal components analysis of the Wind River data were obtained.

52630 (GJBX—114(79)(Vol.1)) **Aerial radiometric and magnetic survey: Needles National Topographic Map, California and Nevada.** (Geodata International, Inc., Dallas, TX (USA)). [nd]. Contract EY-76-C-13-1664. 192p. Dep. NTIS, PC E12/MF E12.

The results of ananlyses of the airborne gamma radiation and total magnetic field survey flown for the region identified as the Needles National Topographic Map NI-11-6 are presented in Volumes I and II of this report. The airborne data gathered are reduced by ground computer facilities to yield profile plots of the basic uranium, thorium and potassium equivalent gamma radiation intensities, ratios of these intensities, aircraft altitude above the earth's surface, total gamma ray and earth's magnetic field intensity, correlated as a function of geologic units. The distribution of data within each geologic unit, for all surveyed map lines and tie lines, has been calculated and is included. Two sets of profiled data for each line are included with one set displaying the above data. The second set includes only flight line magnetic field, temperature, pressure, altitude data plus magnetic field data as measured at the base station. A general description of the area, including descriptions of the various geologic units and the corresponding airborne data, is included also.

52631 (GJBX—124(79)(Vol.1)) **Aerial radiometric and magnetic survey: Brigham City National Topographic Map, Utah.** (Geodata International, Inc., Dallas, TX (USA)). [nd]. Contract EY-76-C-13-1664. 243p. Dep. NTIS, PC E12/MF E12.

The results of analyses of the airborne gamma radiation and total magnetic field survey flown for the region identified as the Brigham City National Topographic Map NK12-7 are presented in Volumes I and II of this report. The airborne data gathered are reduced by ground computer facilities to yield profile plots of the basic uranium, thorium and potassium equivalent gamma radiation intensities, ratios of these intensities, aircraft altitude above the earth's surface, total gamma ray and earth's magnetic field intensity, correlated as a function of geologic units. The distribution of data within each geologic unit, for all surveyed map lines and tie lines, has been calculated and is included. Two sets of profiled data for each line are included with one set displaying the above-cited data. The second set includes only flight line magnetic field, temperature, pressure, altitude data plus magnetic field data as measured at a base station. A general description of the area, including descriptions of the various geologic units and the corresponding airborne data, is included also.

MINING

REFER ALSO TO CITATION(S) 52704

52632 (GJBX—91(79)) **Mining and processing methods and cost models for the recovery of thorium from domestic occurrences.** Lemons, J.F. Jr.; Coppa, L.V. (Bureau of Mines, Denver, CO (USA)). May 1979. Contract EY-76-C-13-1664. 75p. P 04/MF A01.

Three cost estimating models developed by personnel of the Minerals Availability Field Office of the United States Bureau of Mines for use in developing an order-of-magnitude cost evaluation for the recovery of thorium from domestic deposits are described. The models can be used to calculate the cost, in 1977 dollars, for recovery of thorium contained in (1) thorite vein deposits similar to deposits at Wet Mountain, Colorado, and Lemhi Pass, Idaho, (2) fluviatile placer deposits similar to deposits found in the Piedmont Belt of North and South Carolina, and (3) massive carbonatite deposits similar to those found in the Powderhorn District of Colorado. The basic concepts of the cost models are discussed and a cost format, which can be used for applying the models to specific deposits, is presented.

FEED PROCESSING

REFER ALSO TO CITATION(S) 52632, 52659, 52703, 52704, 52708

52633 (RFP—2877) **Chemistry research and development. Progress report, June—November 1978.** Miner, F.J. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 28 May 1979. Contract EY-76-C-04-3533. 64p. P 04/MF A01.

Activities and progress are reported in the following areas: component development, pilot plant development, and instrumentation and statistical systems. (DLC)

GASEOUS DIFFUSION

REFER ALSO TO CITATION(S) 52674

BY-PRODUCTS

DEPLETED URANIUM

52634 (BMI—2032) **Mechanical properties of depleted uranium-2 w/o molybdenum alloy.** Deel, O.L.; Burian, R.J. (Battelle Columbus Labs., OH (USA)). 16 Jul 1979. Contract W-7405-ENG-92-080. 39p. P 03/MF A01.

The primary objective of this program is to develop data and techniques for determining the dynamic impact response of radioactive-material shipping-container systems for environmental control and safety overview and assessment. One phase of this program is the dynamic testing of 1/8-, 1/4-, and 1/2-scale models of uranium-shielded truck casks. These linearly scaled models are fabricated from the same materials typically used in full-size prototype casks. In order to analytically evaluate the results of dynamic tests, it is necessary to know the mechanical properties of the materials of construction. Since the properties of cast uranium—molybdenum alloys vary significantly with casting and heat-treating techniques, it is necessary to fully characterize the mechanical properties of the uranium used in the model tests. This report presents the results of these studies. The uranium alloy exhibited a tensile strength equal to or greater than that reported by others. As indicated by the percentage of elongation and reduction in area, the ductility was lower. Comparative data for the other mechanical properties measured were not found in the literature.

SPENT FUELS REPROCESSING

REFER ALSO TO CITATION(S) 52711, 52713, 52721

52635 (CONF-790707—11) **Computerized quality control techniques.** Halverson, G.D.; Camarata, A.R.; Hand, R.L.; Spraktes, F.W.; Baldwin, J.M. (Allied Chemical Corp., Idaho Falls, ID (USA)). 1979. Contract EY-76-C-14-2170. 49p. P 03/MF A01.

From 20. annual meeting of the Institute of Nuclear Materials Management; Albuquerque, NM, USA (16 Jul 1979).

Examination of historical semi-controlled data related to a current laboratory environment provides a powerful quality control tool by yielding information for such items as: (1) mathematical correction of unidentified systematic deviations; (2) estimation of confidence in lab results; and (3) detection of correctable trends. The object of this presentation is to discuss some concepts of a computerized quality control system. Topics include: (1) data flow and control; (2) use of statistics and graphics in data examination; (3) aspects of human interaction with a computerized system; and (4) the advantages and possible disadvantages of using the described system.

52636 (ESG-DOE—13276) **AIROX dry reprocessing of uranium oxide fuels.** Hoyt, R.C.; Grantham, L.F.; Clark, R.G.; Twichell, P.W. (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). 12 Jul 1979. Contract W-31-109-ENG-38. 120p. AT.

The AIROX pyrochemical dry reprocessing method has been shown to be a highly proliferation resistant means of utilizing fissile material in spent nuclear fuel. Fuel cycles based upon this reprocessing method have been developed for both LWR and FBR fuel. Process analysis with computer codes has determined the relative importance of removing specific fission products and has established that new fuel management strategies need to be developed for fuels recycled with fission products. Process conditions have been optimized with respect to pellet pulverization and reaction rates by performing tests on unirradiated UO_2. These tests yielded a product which is sufficiently pulverized for complete decladding, without production of extremely fine particles to cause dusting problems. An analysis has indicated that the product should not be contaminated with cladding material, and that waste treatment can be accomplished with the technology being developed for aqueous processing

facilities. It appears that waste produced during dry reprocessing will be significantly easier to treat and consist of smaller volumes than those produced by conventional aqueous reprocessing facilities.

52637 (GA-A—15487) **Thermal aspects in the design of an HTGR fuel reprocessing plant.** Park, U.S. (General Atomic Co., San Diego, CA (USA)). Aug 1979. Contract EY-76-C-03-0167-053. 19p. (CONF-790822—9). P 02/MF A01.

From 87. AICHE national meeting; Boston, MA, USA (19 Aug 1979).

HTGR graphite-based spent fuel has been thermally analyzed to provide data for a reprocessing design. Steps include crushing, burning in fluidized beds, size classification, dissolution, and solvent extraction. The principal problem is that the bunkers holding feed and product between steps need sizing for decay heat. Constraints have been set for different modes of cooling. However, criticality may prove stricter. Adverse effects of solvent degradation products in the Acid—Thorex process, mainly dibutyl phosphate (DBP), are reduced by using a partition flowsheet and by adding fluoride ions to the 1BX and 1CX columns.

52638 (IS-T—858) **Effect of backmixing on pulse column performance.** Miao, Y.W. (Ames Lab., IA (USA)). May 1979. Contract W-7405-ENG-82. 152p. P 08/MF A01.

A critical survey of the published literature concerning dispersed phase holdup and longitudinal mixing in pulsed sieve-plate extraction columns has been made to assess the present state-of-the-art in predicting these two parameters, both of which are of critical importance in the development of an accurate mathematical model of the pulse column. Although there are many conflicting correlations of these variables as a function of column geometry, operating conditions, and physical properties of the liquid systems involved it has been possible to develop new correlations which appear to be useful and which are consistent with much of the available data over the limited range of variables most likely to be encountered in plant sized equipment. The correlations developed were used in a stagewise model of the pulse column to predict product concentrations, solute inventory, and concentration profiles in a column for which limited experimental data were available. Reasonable agreement was obtained between the mathematical model and the experimental data. Complete agreement, however, can only be obtained after a correlation for the extraction efficiency has been developed. The correlation of extraction efficiency was beyond the scope of this work.

52639 (LA-UR—79-1842) **Cooling-time determination of spent fuel.** Hsue, S.T.; Hatcher, C.R.; Kaieda, K. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 13p. (CONF-790707—25). P 02/MF A01.

From 20. annual meeting of the Institute of Nuclear Materials Management; Albuquerque, NM, USA (16 Jul 1979).

Two methods to determine the cooling time using data from high-resolution gamma-ray measurements are discussed; one is useful when the irradiation history information is available, the other when the irradiation history is not available. We have applied both methods and found that the cooling time can be determined to within an average of 3% and 4.1%, respectively.

52640 (ORNL/TM—6764) **Literature review of selected methods of molten salt reprocessing of ceramic fuels.** Smith, D.H.; McDuffie, H.F. (Oak Ridge National Lab., TN (USA)). Aug 1979. Contract W-7405-ENG-26. 110p. AT.

PROMEX is the Proliferation Resistant Oak Ridge Molten Salt/Metal Extraction method of reprocessing spent nuclear fuel. This report reviews the chemical and thermodynamic data on which PROMEX is based; it contains twenty-one figures and over four hundred references from the report literature and the open literature through June 1978. The topics covered include (1) halogenation of oxide fuels and their dissolution in molten salts; (2) distribution coefficients for the redox extraction of the coprocessed actinides from molten alkali halides into liquid bismuth; (3) thermodynamic and related data needed for the prediction and interpretation of redox distribution coefficients (free energies of formation, activity coefficients, phase diagrams, solubilities, etc.); and (4) the chemistry and thermodynamics of molten ammonium chloroaluminate (NH_4AlCl_4) used for recovery of the coprocessed actinides from bismuth solutions.

52641 (ORNL/TM—6836) **Consolidated Fuel Reprocessing Program. Progress report, January 1 to March 31, 1979.** Unger, W.E. (comp.). (Oak Ridge National Lab., TN (USA)). Jun 1979. Contract W-7405-ENG-26. 182p. AT.

On Oct. 1, 1978, a transition phase was begun to concentrate all US fuel reprocessing research in one major program, the Consolidated Fuel Reprocessing Program (CFRP). The CFRP is organized into the following: process R and D, engineering research, engineering systems, technical support, HTGR fuel reprocessing, and pyrochemical and dry processing methods. Progress is reported in each area. (DLC)

52642 (ORNL/TM—6837) **Consolidated fuel reprocessing program operational testing of a ferrofluidic seal.** Lewis, B.E.; Morgan, J.G. (Oak Ridge National Lab., TN (USA)). Aug 1979. Contract W-7405-ENG-26. 38p. AT.

The performance of a ferrofluidic seal under simulated conditions expected in a fuel reprocessing plant has been examined. A ferrofluidic seal is composed of a permanent magnetic source, a magnetically permeable focusing structure and ferrofluid. The ferrofluid used in these tests was a dispersion of coated magnetic particles in a perfluoroalkylpolyether base material. Using a specially designed test stand, the seal was tested for breakthrough and reseal pressure differential as a function of time under both static and dynamic conditions. Under concentrically aligned geometry, the breakthrough pressure could be predicted from the magnetic properties of the seal. The breakthrough differential pressure decreased as the shaft increased from 0 to 90 rpm. The radial gap between the seal and shaft was 0.015 in., greater than normal in commercial applications. Upon heating to 125°C, the breakthrough pressure decreased to one-fifth of its ambient temperature value. The tests conducted in a dusty environment using ceramic powder in contact with the ferrofluid caused scoring of the shaft and eventual total seal failure. Seal failure within 25 hr was caused by 8 M HNO_3 vapors at 100°C. Increasing the shaft to seal misalignment reduced the breakthrough differential pressure. Radiation resistance tests showed that this particular ferrofluid was not resistant to gamma radiation exposure above 3 x 10⁸R. It is not recommended that these seals be used on head-end reprocessing equipment without further consideration of seal design for fluid protection and remote ferrofluid replenishment schemes.

52643 (RAND/N—1176-DOE) **Valuation of nuclear reactor spent fuel using the HP 67/97 programmable calculator.** Solomon, K.A.; Triplett, M.B. (RAND Corp., Santa Monica, CA (USA)). Apr 1979. Contract AC01-79TE70078. 46p. P 03/MF A01.

This Note applies the spent fuel valuation procedure of R-2239-DOE to a programmable hand calculator (the Hewlett-Packard 67/97). A modest degree of flexibility enables the program user to examine the impact on spent fuel value of variations in almost 30 parameters (e.g., yellowcake price, reprocessing cost, timing of recycle, U-236 composition, etc.). This program can be used to calculate: the present discounted value (PDV) of 1 kg of spent fuel placed in interim storage and permanently disposed at some future time; the PDV of 1 kg of spent fuel placed in interim storage and reprocessed and recycled into an LWR (or LMFBR) at some future time; the reprocessing (or yellowcake) cost that yields a net zero spent fuel value (i.e., the breakeven cost) in any future year; the contribution to spent fuel value of its uranium and plutonium components; and the enrichment plant feed/product ratio and SWU requirements as a function of product, tails, and feed enrichment.

52644 (RAND-P—6308) **International cooperation in nuclear fuel services: European and American approaches.** Mendershausen, H. (RAND Corp., Santa Monica, CA (USA)). Dec 1978. 104p. Rand Corp., Santa Monica, CA.

The US and Europe now are further apart on fuel cycle policies than was the case several years ago. Current US policy is now aimed at once-through fuel use (throwaway fuel cycle) and at making US supplies of nuclear materials and services to others dependent on their abstention from sensitive activities; the Europeans reject this policy. This document reviews the evaluation of US views and proposals and the experiences of European multinational fuel ventures. The reviews indicates fundamental differences and potential compatibilities. The conclusion is made that multinational fuel enterprise schemes offer no promise for resolving the dispute over countries rights to sensitive facilities. (DLC)

52645 (UCRL—15101) **Survey of simulation methods for modeling pulsed sieve-plate extraction columns.** Burkhart, L. (Ames Lab., IA (USA)). Mar 1979. Contract W-7405-ENG-48. 96p. P 05/MF A01.

The report first considers briefly the use of liquid-liquid extraction in nuclear fuel reprocessing and then describes the operation of the pulse column. Currently available simulation models of the column are reviewed, and followed by an analysis of the information presently available from which the necessary parameters can be obtained for use in a model of the column. Finally, overall conclusions are given regarding the information needed to develop an accurate model of the column for materials accountability in fuel reprocessing plants. 156 references.

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 52686, 52693, 52694, 52701, 53540, 53541

52646 (HEDL-TME—77-22) **Effects of environments on spent fuel.** Funk, C.W.; Jacobson, L.D.; Menon, M.N. (Hanford Engineer-

ing Development Lab., Richland, WA (USA)). Jul 1979. Contract EY-76-C-14-2170. 48p. P 03/MF A01.

This report describes the influence of water storage environment and transportation on spent light water reactor (LWR) fuel assemblies. It also estimates the storage duration and capacity requirements for several assumed scenarios.

52647 (RHO-LD—86) **Commercial Waste and Spent Fuel Packaging Program. Thermal simulation test of spent fuel in drywell storage.** Tignac, L.L. (Atomics International Div., Richland, WA (USA). Rockwell Hanford Operations). Jun 1979. Contract EY-77-C-06-1030. 34p. P 03/MF A01.

In the drywell storage concept, spent fuel assemblies are packaged in steel canisters and placed in a surface storage facility consisting of an array of steel-lined drywells. The spacing of the drywells in the array depends on the capability of the soil to dissipate heat and on the allowable maximum spent fuel temperature. The drywell demonstration activity at Hanford consisted of the operation of a full-scale mockup of a drywell storage unit, using an electrical heater to simulate the thermal power of a spent fuel package. This demonstration unit was operated for a 1-year period with a constant heat output of 1 kW while the drywell and surrounding soil temperatures were monitored by an array of thermocouples. The 1 kW thermal power roughly corresponds to the power output of a 5-year-old PWR spent fuel assembly. The temperature distributions were calculated using the heat conduction code HEATING5. The input thermal parameters were estimated from the measured data and recent Hanford soil studies. An estimate of the effective soil conductivity was obtained by a comparison of the measured temperature data with the calculated soil temperature distributions using a range of conductivities. Results indicated that evaporation of the soil moisture initially present around the drywell, and subsequent water vapor migration upward, are significant heat transfer mechanisms and tend to reduce the drywell temperatures below what would be expected in totally dry soil. The demonstration showed that the drywell storage concept is feasible from the heat transfer standpoint. 20 figures.

52648 (SAND—78-2447C) **Geotechnical aspects of interim near-surface storage of spent nuclear fuel.** McNeill, R.L. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 18p. (CONF-791004—1). Dep. NTIS, PC A02/MF A01.

From ASCE national meeting; Atlanta, GA, USA (Oct 1979).

The geotechnical problems associated with interim near-surface storage involve long-term settlements and dynamic earthquake response. The problems are not specifically different from those encountered in the design of other Class-I structures, but they do require specific attention to the details outlined in the paper. Proposed rules for future Away From Reactor (AFR) storage facilities are reviewed, particularly the 0.25-g reference design acceleration criterion.

52649 (SRO—1051-2) **Alternatives for water basin spent fuel storage using shot filled containers and compaction. Part II.** Carlson, R.W. (Nuclear Assurance Corp., Atlanta, GA (USA)). Sep 1979. Contract EW-78-C-09-1051. 191p. (NAC-C—7916). P 09/MF A01.

One of the parameters that controls storage density in water basin spent fuel storage is the spacing between fuel assemblies to control the neutron multiplication rate. One of the easiest methods to reduce neutron multiplication, allowing closer spacing and greater storage density, is to eliminate water from the open volume within the fuel assembly. This can be accomplished by filling this space with a nonhydrogenous material. The only practical material is a particulate solid, e.g., metallic shot. The storage concept of containerization of fuel assemblies utilizing backfilling with metallic shot is the subject of Section A of this report. Evaluation of nuclear, thermal and structural aspects of the equipment and container design indicates that the storage density will be 0.78 MTU/ft^2 for PWR fuel and 0.68 MTU/ft^2 for BWR fuel. Total cost for the development, installation, and use of this system is between $17,800 and $28,300 per MTU of fuel stored using stainless steel shot. Section B of this report discusses the concept of fuel assembly compaction. compacting the fuel assemblies to reduce the spacing between fuel rods to the thickness of the spacer material increases the storage density to 0.94 MTU/ft^2. The upper and lower end fittings have to be cut off prior to compacting the fuel assembly to remove the massive castings that would interfere with compaction. The fuel assembly is inside a malleable canister during the compaction process and is placed inside a stainless steel canister for storage. Total cost for the development, installation, and use of this system for 5-year-old fuel is between $1900 and $9530 per MTU of fuel stored.

52650 (UCRL—15060(Add.1)) **Monitoring instrumentation spent fuel management program. Final report.** (EA and T Co., Inc., Marina del Rey, CA (USA)). Jan 1979. Contract W-7405-ENG-48. 159p. P 08/MF A01.

Preliminary monitoring system methodologies are identified as an input to the risk assessment of spent fuel management. Conceptual approaches to instrumentation for surveillance of canister position and orientation, vault deformation, spent fuel dissolution, temperature, and health physics conditions are presented. In future studies, the resolution, reliability, and uncertainty associated with these monitoring system methodologies will be evaluated.

52651 (UCRL—15076) **Instrument selection, installation, and analysis of data for the spent fuel mine-by, Nevada Test Site, Climax Stock.** Schrauf, T.; Board, M. (Terra Tek, Inc., Salt Lake City, UT (USA)). Jul 1979. Contract W-7405-ENG-48. 104p. P 06/MF A01.

During the time period of February to April, 1979, twelve rod extensometers and twenty-two convergence measurement points were installed, calibrated and monitored in support of the spent fuel mine in granite. Readings taken during heading and bench advance shows good instrument stability, with little or no anchor creep or slippage. Repeat calibrations indicate excellent repeatability. Measurement points within the heater drifts indicate little closure. Convergence pins within the spent fuel drift were subjected to significant blast damage that resulted in a discontinuous record. A numerical analysis of the stresses and displacements of the rock mass as a result of the mine-by was performed. Two methods, finite element and displacement discontinuity, were used to model the mine-by. Comparison of the actual to predicted displacements show good agreement for the 33^0 and 50^0 extensometers for a rock mass modulus of 3 to 5 x 10^6 psi and Poisson's ratio of .2. The horizontal extensometers however indicate a convergence of anchor and collar (divergence predicted) and the IRAD stressmeters installed within the pillar indicate a significant reduction in vertical compression during mining of the heading. A simple reduction of pillar modulus will not account for the observed stress and displacement changes. Varying the ratio of vertical to horizontal stress ratio over the range .8 to 1.25 also did not account for observed stresses and displacements. It is concluded that the displacements andstresses are a result of block motion or joint slippage within the pillars. This is primarily the result of the small dimensions of the pillars in relation to the spent fuel and heater drifts. This joint slippage can account for the formation of a stable stress arch around the openings and thus a relaxation of the pillar.

52652 (UCRL—52796) **Technical concept for a test of geologic storage of spent reactor fuel in the climax granite, Nevada Test Site.** Ramspott, L.D.; Ballou, L.B.; Carlson, R.C.; Montan, D.N.; Butkovich, T.R.; Duncan, J.E.; Patrick, W.C.; Wilder, D.G.; Brough, W.G.; Mayr, M.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Jun 1979. Contract W-7405-ENG-48. 52p. P 04/MF A01.

We plan to emplace spent fuel assemblies from an operating commercial nuclear reactor in the Climax granite at the US Department of Energy's Nevada Test Site. In this generic test, 11 canisters of spent fuel will be emplaced with 6 electrical simulator canisters in a storage drift 420 m below in surface and their effects compared. Two adjacent drifts will contain electrical heaters, operated to simulate the temperature-stress-displacement fields of a large repository. We describe the test objectives, the technical issues, the site, the preoperational measurement program, thermal and mechanical response calculations, the characteristics of the spent fuel, the field instrumentation and data-acquisition systems, and the system for handling the spent fuel.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 52632

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 52633, 52708

52653 (DOE/SR-WM—79-1) **Alternatives for long-term management of defense transuranic waste at the Savannah River Plant, Aiken, South Carolina.** (Department of Energy, Washington, DC (USA)). Jul 1979. Contract EY-76-C-09-0001. 782p. P 13/MF A01.

Costs and risks are estimated for 12 alternatives for the long-term management of defense transuranic waste now stored in trenches and on pads at the Savannah River Plant. The alternatives range from the no-action alternative to the alternative where all waste is retrieved, fixed in concrete or glass, and disposed of in deep geologic facilities. For a 10-year processing and a 100-year surveillance period, estimated costs range from under 25 million (1979) dollars for the no-action alternative to over 500 million dollars for fixation of all transuranic waste and disposal in bedrock. Time-integrated risks range from 13,000 man-rem for the no-action alternative to 50 man-rem for alternatives in which all waste is placed either in onsite trenches or overpacked and placed in geologic disposal facilities. If institutional control of the onsite trench area ceases after 100 years, radiation doses to the public over the next 1000-year period would

range from about 20,000 man-rem for the no-action alternative down to 100 to 300 man-rem for the action alternatives.

52654 (DP-MS—79-23(Rev.)) **Predicted environmental impacts of long-term waste management at the Savannah River Site.** Topp, S.V. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1979. Contract EY-76-C-09-0001. 22p. (CONF-790822—8(Rev.)). P 02/MF A01.

From 87. AICHE national meeting; Boston, MA, USA (19 Aug 1979).

This paper describes the different alternative approaches to long-term waste management at SRP, along with their probable relative costs, risks, and uncertainties; the issue of methodology for decision-making in nuclear waste management is also raised. This paper contains a preliminary listing of the SRP alternaties including a simple cost-risk analysis. The alternatives are: glass shipped offsite to Federal repository; air-cooled vault with glass at SRP; liquid waste slurry stored in SRP bedrock cavern; and continued tank farm operation with salt and sludge. (DLC)

52655 (LA-UR—78-326) **^{3}He detector design for low-level transuranic waste assay.** Hendricks, J.S.; Close, D.A. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 6p. P 02/MF A01.

From this study it appears that a logical configuration of ^{3}He detectors imbedded in CH_2 for nondestructive assay of low-level transuranic waste is: rho = 1 atmosphere, d = 2.54 cm, x = 5.08 cm, t = 15.24 cm, h = 61 cm, and N = 5. If a greater detector response is desired, the best way to achieve it is to first double the detector height, h, and then to increase the number of tubes, N, and/or increase the ^{3}He density, rho.

52656 (PNL—2668-2) **Multibarrier waste forms. Part II. Characterization and evaluation.** Rusin, J.M.; Gray, W.J.; Wald, J.W. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1979. Contract EY-76-C-06-1830. 66p. P 04/MF A01.

The multibarrier concept for the storage of radioactive waste is to use up to three barriers to isolate radionuclides from the environment: a solidified waste inner core, an impervious coating, and a metal matrix. The four multibarrier waste forms were evaluated for thermal stability (volatility), mechanical strength (impact resistance), and leach resistance. This report discusses the characterization of the multibarrier waste forms and compares them to reference calcine and glass waste forms. The weight loss of supercalcine-ceramics after 4 h in dry air ranges between 0.01 and 1.6 wt % from 1000 to 1200°C and is dependent upon composition. Glass marbles in a cast lead alloy offer approximately an order of magnitude decease in the wt % fines < 37 μm released after impact as compared to a glass monolith. CVD-coated supercalcine in a sintered 410 SS matrix offers up to two orders of magnitude decrease. Hot-pressed supercalcine ceramics may offer no increase in impact resistance or leach resistance over that of a glass monolith. Supercalcine may offer no advantage over waste glasses in leach resistance. Glass and PyC/Al_2O_3 coatings provide effective inert leaching barriers.

52657 (UCID—18133(Vol.1)) **Abstracts: NRC waste management program reports.** Heckman, R.A.; Minichino, C. (eds.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). Aug 1979. Contract W-7405-ENG-48. 129p. P 07/MF A01.

This document consists of abstracts of all reports published by the NRC Waste Management Program at Lawrence Livermore Laboratory. Reports are arranged in numerical order, within each category.

52658 (UCID—18241) **Synopsis of talk on Bead Leach I Analysis.** Coles, D.G.; Garrison, J.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Aug 1979. Contract W-7405-ENG-48. 10p. P 02/MF A01.

The following are reported and discussed: status of Bead Leach I analyses as of 5/17/79, composition of 76-68 glass and detection limits for ICP analysis of leachate, and acid calibration data for ICP analysis (replicate runs of standard solution in Ultrex HNO_3). 5 figures. (DLC)

52659 **Putting tailings in perspective radiologically, environmentally and managerially.** Shreve, J.D. Jr. (Kerr-McGee Corp., Oklahoma City, OK (USA)). pp 401-406 of Management, stabilisation and environmental impact of uranium mill tailings. Paris, France; OECD Nuclear Energy Agency (1978).

From Management, stabilization, and environmental impact of uranium mill trailings; Albuquerque, NM, USA (24 Jul 1978).

Present management of uranium mill tailings is sophisticated compared with recounted practices of 15 to 20 years ago. Further improvements while possible and wanted should not be rushed. Many factors enter. The paper suggests routes to selecting radiological protective standards, elucidates the site-specific and process-specific nature of tailings control, provides comparative references on source terms of radon, uranium, thorium and radium, defends the need for multiple control and for plan endorsement in perpetuity once approval is granted, except as improved control at lesser cost proves doable. One idea is proffered for reducing tailings mass to one-third that accumulated by current practises.

WASTE PROCESSING

REFER ALSO TO CITATION(S) 52682

52660 (EUR—5897) **1. Technical meeting on the nuclear transmutation of actinides.** (Commission of the European Communities, Ispra (Italy). Joint Research Centre). 1978. 472p. U 20/MF A01.

Individual papers were abstracted separately.

52661 (EUR—5897, pp 51-78) **Technological impacts of partitioning-transmutation on the nuclear fuel cycle.** Croff, A.G. (Oak Ridge National Lab., TN (USA)). 1978.

From 1. technical meeting on the nuclear transmutation of acinides; Ispra, Italy (16 Apr 1977).

This paper defines and discusses the potential technological impacts of partitioning-transmutation on the nuclear fuel cycle, excluding the impacts on the physics of the transmutation reactor and the reprocessing and refabrication plant flowsheets. Potential negative fuel cycle impacts which presently appear to be important include the increase in routine fuel cycle effluents, increased biological neutron shielding requirements, increased economic cost, and the uncertain disposition of current and near-term spent reactor fuels. The magnitude of many of these impacts is not presently quantifiable because of a lack of research in these areas. Potential positive fuel cycle impacts include a reduction in the long-term toxicity of radioactive wastes and the possibility that the highly neutron-active recycled actinide might be used to 'spike' strategic nuclear materials. Based on an analysis of existing studies related to the fuel cycle impacts of partitioning-transmutation, it is clear that (1) the fuel cycle impacts and the reactor physics aspects of partitioning-transmutation would be heavily interdependent, and (2) that considerable work is required to adequately define the potential fuel cycle impacts of partitioning-transmutation.

52662 (EUR—5897, pp 115-127) **Conceptual methods for actinide partitioning.** Leuze, R.E.; Bond, W.D.; Tedder, D.W. (Oak Ridge National Lab., TN (USA)). 1978.

From 1. technical meeting on the nuclear transmutation of acinides; Ispra, Italy (16 Apr 1977).

The conceptual processing sequence under consideration is based on a combination of modified Purex processing and secondary processing of the high-level waste. In this concept, iodine will be removed from dissolver solution prior to extraction, and the Purex processing will be modified so that low- and intermediate-level wastes, all the way through final product purification, are recycled. A supplementary extraction is assumed to ensure adequate recovery of uranium, neptunium and possibly plutonium. Technetium may be removed from the high-level waste if a satisfactory method can be developed. Extraction into a quaternary amine is being evaluated for this removal. Methods that have been used in the past to recover americium and curium have some rather serious deficiencies, including inadequate recovery, solids formation and generation of large volumes of low- and intermediate-level wastes containing significant quantities of chemical reagents.

52663 (NUREG/CP—0005, pp 623-650) **Crystalline and coated high-level forms.** McCarthy, G.J. (Pennsylvania State Univ., University Park). 1979.

From Conference on high-level radioactive solid waste; Denver, CO, USA (19 Dec 1978).

It is in the waste form that one has the best opportunity to apply science to high-level waste isolation. Th more stable the waste form is in its isolation environment, the less need be the dependence on engineered and geological barriers to radionuclide release. In this presentation, current work aimed at producing high stability, second generation, primarily crystalline waste forms is reviewed. Existing data on the hydrothermal stability of these forms are summarized. It is noted that partitioning of the waste stream could facilitate further improvements in these products. Research and development needs for crystalline ceramic waste forms are described. 3 figures, 5 tables.

52664 (ORNL/TM—6863) **Preliminary engineering and economic analysis of the fixation of high-level radioactive wastes in concrete.** Weeren, H.O.; Perona, J.J. (Oak Ridge National Lab., TN (USA)). Jul 1979. Contract W-7405-ENG-26. 62p. P 04/MF A01.

This feasibility study was based on a waste fixation facility that would serve a reprocessing plant with a capacity of 5 metric tons of uranium per day (MTU/day). Postirradiation cooling times of 3 to 10 years prior to waste solidification were assumed. The waste solution would be concentrated, denitrated, mixed with cement, and cast under pressure in cylindrical canisters similar to those envisioned for a glass facility. The solidified waste grout would be vented, to allow the free water to escape, and then sealed. The filled canisters would be shipped to a geologic repository for permanent storage. Recent work with concretes formed under ele-

vated temperatures and pressures (FUETAP) indicates that they are highly leach resistant. The operating costs were estimated for a waste fixation facility under several conditions. Operating costs for a glass fixation facility were also estimated and compared with the operating costs for a concrete fixation facility. The principal conclusion is that concrete could be an alternative to glass as a matrix for fixation of wastes with high heat-generation rates. The operating costs of an optimized concrete fixation process would probably not be greatly higher than the operating costs of a glass plant, and the capital costs would almost surely be lower. In addition, the concrete process is not a high-temperature process and would not have the consequent operating problems.

52665 (ORNL/TM—7013) **High-level waste program. Progress report, April 1, 1979-June 30, 1979.** (Oak Ridge National Lab., TN (USA)). Aug 1979. Contract W-7405-ENG-26. 40p. P 03/MF A01.

The development of a low-level waste management analysis computer code has focused on modifying existing codes for commercial and DOE wastes to increase their capabilities, and on reorganizing the data bases. The ORIGEN nuclear data library was supplemented with information that will permit calculations of PWRs fueled with denatured ^{233}U and ^{235}U in ThO_2. Preliminary results of the risk analyses of partitioning and transmutation show only a negligible increase in short-term risk, but also indicate virtually no reduction in the long-term ($\leqq$ 1 million years) risk from implementation of this concept. Compressive strengths of FUETAP (Formed Under Elevated Temperature and Pressure) concretes made at 100°C increased with increasing curing pressure. Strontium leachability from FUETAP concrete is essentially diffusion controlled whereas two mechanisms are probably involved in the leachability of cesium. Hydrogen and oxygen recombination studies continue to suggest that pressurization due to radiolysis may be minimal because of the excellent catalytic properties of the solids. A spray calciner has been built and operated successfully with drastic reductions in the amount of urea addition required. SEM metallographic examination of the cermet sample formed with actual SRP fresh acid waste showed improved densification over that obtained during the first hot-cell experiment which was performed using actual NFS Acid Thorex waste. The sampling and analysis of NFS waste supernate have been completed. Engineering analyses of the cermet process which have been initiated by groups at SRL and PNL are resulting in a shift of programmatic efforts to support these analyses.

52666 (PNL—3000-1) **Nuclear waste management. Quarterly progress report, January—March 1979.** Platt, A.M.; Powell, J.A. (comps.). (Battelle Pacific Northwest Labs., Richland, WA (USA)). May 1979. Contract EY-76-C-06-1830. 89p. P 05/MF A01.

Work on the following topics is reported: decontamination and densification of chop-leach cladding residues, monitoring methods for particulate and gaseous effluents from waste solidification processes, TRU waste immobilization, krypton solidification, ^{14}C and ^{129}I fixation, waste management system and safety, waste isolation safety assessment, well logging instrumentation for shallow land burial, monitoring and physical characterization of unsaturated zone transport, detection and characterization of mobile organic complexes of fission products, and electropolishing for surface decontamination of metals. 29 figures, 17 tables. (DLC)

52667 (PNL—3038) **Technical summary: Nuclear Waste Vitrification Project.** Wheelwright, E.J.; Bjorklund, W.J.; Browne, L.M.; Bryan, G.H.; Holton, L.K.; Irish, E.R.; Siemens, D.H. (Battelle Pacific Northwest Labs., Richland, WA (USA)). May 1979. Contract EY-76-C-06-1830. 82p. P 05/MF A01.

Six PWR fuel assemblies, containing 2.3 metric tons uranium from Point Beach, have been processed by a conventional Purex-type process. U and other chemicals were added to the dilute HLLW, and the waste was then vitrified to produce two canisters of glass. The on-stream efficiency of the waste preparation facility exceeded 90% for the first 3 weeks; the overall average was 62%. The only processing difficulty in the vitrification facility was a partial failure in the spray calciner nozzle. The Pu byproduct of waste preparation was purified by ion exchange and calcined to oxide; one can of oxide ruptured due to self-heating. 27 figures, 16 tables. (DLC)

52668 (RFP—2915) **Utilization of borosilicate glass for transuranic waste immobilization.** Ledford, J.A.; Williams, P.M. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1979. Contract EY-76-C-04-3533. 10p. (CONF-790597—1). P 02/MF A01.

From International symposium on ceramics in nuclear waste management; Cincinnati, OH, USA (2 May 1979).

The externally heated metal vitrification reactor has been in operation for more than two years but has, during periodic inspections, revealed no indications of serious corrosion or other deterioration. The furnace has performed similarly, requiring only the replacement of one glowbar and one fuse during the period. Glass that has been produced by the process is of consistent high quality exhibiting high resistance to physical abuse while accommodating a large amount of waste material. Fully 67% of the glass, by weight, is waste. The reslting need for only relatively small amounts of forming agents contributes to the considerable volume reduction obtainable with this process. The glass, in monolithic form, occupies only 16% of the volume of its dry constituents, including forming agents.

52669 (UJV—4321-Ch) **Study of phosphate systems intended for high-level waste fixation. Fission products, Fe_2O_3, P_2O_5 system.** Vojtech, O.; Santarova, M.; Stejskal, J.; Suessmilch, J. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). Jan 1978. 22p. (In Czech). U 03/MF A01.

The system fission products - Fe_2O_3 - P_2O_5 was investigated, regarding its use for high level radioactive wastes solidification. X-ray diffraction analysis and electron microanalysis results were correlated with the values of solubility and leachability of certain important elements from the fixation products. In the system studied, three main areas were found with regard to their macrostructure: two of crystalline nature, one amorphous (glassy state). The anomalous behavior of products in the region of low P concentration was explained, using results gained by detailed microprobe analysis. The information so far obtained is of great importance for the further study of the technological process.

52670 **Volume reduction of low-level radioactive waste.** Johnson T.C.; Bell, M.J. (US Nuclear Regulatory Commission, Washington, DC). *Trans. Am. Nucl. Soc., Suppl.;* **32**: No. 1, 19(1979).

WASTE DISPOSAL AND STORAGE

REFER ALSO TO CITATION(S) 52650, 52652, 52663, 52666, 52706, 52707, 52709, 53285, 53286, 53287, 53588, 53589, 53761

52671 (BNL—26333) **Leaching properties of solidified TRU waste forms.** Colombo, P.; Neilson, R.M. Jr. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 25p. (CONF-790596—1). P 02/MF A01.

From 2. WISAP task workshop - Waste isolation safety assessment program; Seattle, WA, USA (24 May 1979).

Safety analysis of waste forms requires an estimate of the ability of these forms to retain activity in the disposal environment. This program of leaching tests will determine the leaching properties of TRU contaminated incinerator ash waste forms using hydraulic cement, urea—formaldehyde, bitumen, and vinyl ester—styrene as solidification agents. Three types of leaching tests will be conducted, including both static and flow rate. Five generic groundwaters will be used. Equipment and procedures are described. Experiments have been conducted to determine plate out of ^{239}Pu, counter efficiency, and stability of counting samples. (DLC)

52672 (DP—1483) **Chemical characterization of SRP waste tank sludges and supernates.** Gray, L.W.; Donnan, M.Y.; Okamoto, B.Y. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Aug 1979. Contract EY-76-C-09-0001. 141p. P 07/MF A01.

Most high-level liquid wastes at the Savannah River Plant (SRP) are byproducts from plutonium and enriched uranium recovery processes. The high-level liquid wastes generated by these separations processes are stored in large, underground, carbon-steel tanks. The liquid wastes consist of: supernate (an aqueous solution containing sodium, nitrate, nitrite, hydroxyl, and aluminate ions), sludge (a gelatinous material containing insoluble components of the waste, such as ferric and aluminum hydroxides, and mercuric and manganese oxides), and salt cake (crystals, such as sodium nitrate, formed by evaporation of water from supernate). Analyses of SRP wastes by laser-Raman spectrometry, atomic absorption spectrometry, spark-source mass spectrometry, neutron activation analysis, colorimetry, ion chromatography, and various other wet-chemical and radiochemical methods are discussed. These analyses are useful in studies of waste tank corrosion and of forms for long-term waste storage.

52673 (DPSPU—79-11-8) **1978 radioactive waste tank inspection program.** Boyleston, R.L.; Knowles, M.A.; Baldwin, J.A.; McNatt, F.G. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). Jul 1979. Contract EY-76-C-09-0001. 12p. P 02/MF A01.

The 1978 tank inspection program was completed with inspections through all 158 accessible annulus risers on the double-wall tanks using at least one photographic technique at each riser. No unusual conditions were noted. Inspections were begun on tanks 25 to 28 which are in the late stages of construction; they will be completed during 1979. Eleven waste tank interior inspections were made with all conditions appearing normal. All three photographic techniques were used to record the progress of the tank 16 annulus cleaning demonstration (TA 2-850) and the tank 16 sludge removal demonstration (TA 2-943). An improved periscope with a black and white TV system was used during the sludge removal demonstration. Wall thickness measurements were made in three annulus risers;

no general corrosion was discovered. Approximately 4,000 photographs were taken in 1978; 25% of them were of tank 16.

52674 (K/ET—131) **Long-term disposal of enrichment plant tails.** Leone, S.M.; Richardson, E.W.; Knight, R.G.; McGinnis, C.P.; Pashley, J.H. (Paducah Gaseous Diffusion Plant, KY (USA); Oak Ridge Gaseous Diffusion Plant, TN (USA)). 18 Dec 1978. Contract W-7405-ENG-26. 37p. P 03/MF A01.

It was assumed that a water insoluble uranium compound essentially free of fluorides would be the desired form for the final storage of cascade tails. UO_2 produced in a two-step process in which the UF_6 is reduced to UF_4 with hydrogen in a tower reactor, followed by pyrohydrolysis to UO_2 with steam in a screw reactor, has been selected as a suitable compound for storage. The UO_2 would be stored in 55-gallon steel drums holding approximately 900 kg, and the drums would be warehoused until a permanent storage facility could be developed. Approximately one-third of the fluoride content of the UF_6 will be recovered as anhydrous HF with potential for industrial sale, while the remaining fluoride content will be reacted with limestone and disposed of in landfills. The magnitude of the conversion process is illustrated by considering a typical electrical generation rate of 50 GW(e) per year. At this level, two plants nominally sized at 10 metric tons of uranium per day will be required.

52675 (LA—7839-PR) **Potential microbial impact on transuranic wastes under conditions expected in the Waste Isolation Pilot Plant (WIPP). Progress report, December 15, 1978-March 15, 1979.** Barnhart, B.J.; Campbell, E.W.; Hardin, J.M.; Martinez, E.; Caldwell, D.E.; Hallett, R. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 14p. P 02/MF A01.

This progress report for the second quarter of FY 1979 relates a number of achievements in both the microbiological and chemical aspects of the project. The number of microflora in burial site soil cores to a depth of 120 cm decreased with depth. The microflora on flammable (organic) waste contaminated with ^{239}Pu were enumerated and bacteria were classed as bacilli or cocci and by reaction to the gram stain. Microflora were also enumerated on a sample of LASL-simulated organic waste. Bacteria and actinomycetes isolated from burial site soil samples containing beta and gamma activity had more radioresistant isolates in the population than microorganisms from soil lacking detectable radioactivity. The alkylation of europium and thorium using methylcobalamine as a methyl donor was attempted but no organometallic product other than cobalt-cobalamine could be detected chemically or by mass spectrometry. A statistical analysis of the rates of degradation of europium tartarate and europium citrate chelates is presented.

52676 (LA—7962-MS) **Preliminary evaluation of the radioactive waste isolation potential of the alluvium-filled valleys of the Great Basin.** Smyth, J.R.; Crowe, B.M.; Halleck, P.M.; Reed, A.W. (Los Alamos Scientific Lab., NM (USA)). Aug 1979. Contract W-7405-ENG-36. 24p. P 02/MF A01.

The occurrences, geologic features, hydrology, and thermal, mechanical, and mineralogical properties of the alluvium-filled valleys are compared with those of other media within the Great Basin. Computer modeling of heat conduction indicates that heat generated by the radioactive waste can be dissipated through the alluvium in a manner that will not threaten the integrity of the repository, although waste emplacement densities will be lower than for other media available. This investigation has not revealed any failure mechanism by which one can rule out alluvium as a primary waste isolation medium. However, the alluvium appears to rank behind one or more other possible media in all properties examined except, perhaps, in sorption properties. It is therefore recommended that alluvium be considered as a secondary isolation medium unless primary sites in other rock types in the Great Basin are eliminated from consideration on grounds other than those considered here.

52677 (LBL—7051) **Fracture detection in crystalline rock using ultrasonic shear waves.** Waters, K.H.; Palmer, S.P.; Farrell, W.E. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1978. Contract W-7405-ENG-48. 53p. (SAC—19). P 04/MF A01.

An ultrasonic shear wave reflection profiling system for use in the detection of water-filled cracks occurring within a crystalline rock mass is being tested in a laboratory environment. Experiments were performed on an irregular tensile crack induced approximately 0.5 m below one circular face of a 1.0-m-dia, 1.8-m-long granite cylinder. Good reflection data were obtained from this irregular crack with the crack either air filled or water filled. Data were collected that suggest a frequency-dependent S/sub H/ wave reflection coefficient for a granite-water interface. Waves that propagate along the free surface of a rock mass (surface waves) can severely hinder the detection of reflected events. Two methods of reducing this surface wave noise were investigated. The first technique uses physical obstructions (such as a slit trench) to scatter the surface waves. The second technique uses a linear array of receivers located on the free surface to cancel waves that are propagating parallel to the array (e.g., surface waves), thus enhancing waves with propagation vectors orthogonal to the linear array (e.g., reflected events). Deconvolution processing was found to be another method useful in surface wave cancellation.

52678 (LBL—8730(Vol.2)) **Heater test planning for the Near Surface Test Facility at the Hanford reservation. Volume II. Appendix.** DuBois, A.; Binnall, E.; Chan, T.; McEvoy, M.; Nelson, P.; Remer, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1979. Contract W-7405-ENG-48. 194p. P 09/MF A01.

Volume II contains the following information: theoretical support for radioactive waste storage projects - development of data analysis methods and numerical models; injectivity temperature profiling as a means of permeability characterization; geophysical holes at the Near Surface Test Facility (NSTF), Hanford; proposed geophysical and hydrological measurements at NSTF; suggestions for characterization of the discontinuity system at NSTF; monitoring rock property changes caused by radioactive waste storage using the electrical resistivity method; microseismic detection system for heated rock; Pasco Basin groundwater contamination study; a letter to Mark Board on Gable Mountain Faulting; report on hydrofracturing tests for in-situ stress measurement, NSTF, Hole DC-11, Hanford Reservation; and borehole instrumentation layout for Hanford Near Surface Test Facility.

52679 (NUREG/CP—0005, pp 395-455) **Stresses and cracking in high-level waste glass.** Slate, S.C.; Bunnell, L.R.; Ross, W.A.; Simonen, F.A.; Westsik, J.H. Jr. (Pacific Northwest Lab., Richland, WA). 1979.

From Conference on high-level radioactive solid waste; Denver, CO, USA (19 Dec 1978).

The purpose of this paper is to discuss the causes and consequences of cracking of high-level waste (HLW) glass in large canisters. Under normal operating conditions a certain amount of cracking is expected. The major causes of cracking are thermal and residual stresses in the glass. Cracking can also be caused by severe impacts, although this is expected to occur rarely. In this paper we present data on the cracking of simulated HLW glass in full-scale canisters filled by the in-can melting and the continuous melting vitrification processes. We discuss how cracking occurs and how it affects the performance of the glass. Comments on how alternative waste forms compare to glass are made where information is available. We conclude that the amount of cracking in HLW glass can be controlled within acceptable limits. 24 figures.

52680 (NUREG/CP—0005, pp 459-475) **Weathering of natural glasses.** Tombrello, T.A. (California Inst. of Tech., Pasadena). 1979.

From Conference on high-level radioactive solid waste; Denver, CO, USA (19 Dec 1978).

The weathering of naturally occurring forms of glass provides clues which can help us understand the variables that control the long-term stability of man-made glasses. In this regard, the study of obsidian and tektite glass are particularly relevant to the vitreous forms proposed for high-level waste disposal. For these natural glasses the leaching rate is quite slow, and their weathering is mainly caused by surface hydration. The hydration process leads to the loss of alkali metals and the formation of a surface layer that has a density different from that of the bulk material. As this layer grows thicker, the strain at the interface with the material in the interior causes cracking and exfoliation of the hydrated coating. The resulting surface topography becomes rougher, which because of the increased surface area accelerates the weathering process. Thus, exfoliation, composition changes, and cracking are linked to the hydration process and are governed by its rate. Two of the variables that are directly correlated with an increased hydration rate are alkali metal and intrinsic H_2O content in the bulk material, while Ca and Fe contents tend to have an inverse correlation. 2 tables.

52681 (NUREG/CP—0005, pp 657-707) **Metamict state: radiation damage in crystalline phases.** Ewing, R.C.; Haaker, R.F. (Univ. of New Mexico, Albuquerque). 1979.

From Conference on high-level radioactive solid waste; Denver, CO, USA (19 Dec 1978).

The long term effect of radiation damage on waste disposal mediums, either crystalline or glass, is a critical factor in the evaluation of the integrity of the waste disposal mediums. Natural analogs, such as metamict minerals, provide an excellent basis for the evaluation of radiation damage effects that might be observed in crystalline waste forms, such as the supercalcine or SYNROC. Metamict minerals are a special class of amorphous materials which were initially crystalline. Although the mechanism for the loss of crystallinity in these minerals (mostly actinide containing oxides and silicates) is not clearly understood, damage caused by alpha particles and recoil nuclei is certainly critical to the metamictization process. The study of metamict minerals allows the evaluation of the long-term radiation damage effects, particularly changes in physical and chemical properties such as microfracturing, hydrothermal alteration and solubility. Comparison of metamict and non-metamict polymorphs, such as thorite an huttonite ($ThSiO_4$), provides a basis for the evaluation of the susceptibility of different structure types to radiation damage.

Short term radiation damage experiments of these phases can be validated by comparing the results to long term radiation damage observed in minerals, such as huttonite, thorite and zircon. This report summarizes the pertinent literature on metamictization and proposes experiments that are critical to the elucidation of structural controls on radiation damage in crystalline phases. 3 tables.

52682 (NUREG/CP—0005, pp 713-731) **DOE program in high level waste immobilization.** Oertel, G.K. (Dept. of Energy, Washington, DC). 1979.

From Conference on high-level radioactive solid waste; Denver, CO, USA (19 Dec 1978).

Strategy for high-level waste was summarized. Alternatives for the waste at each site and their different chemical and physical characteristics were assessed. The immobilization program interfaced with the repository development program to assure that the waste form would be compatible with the repository system. Selection factors for high-level waste forms were summarized. Waste form technology has been affected by several recent developments. Measurements showing glass will leach rapidly at extreme temperature and pressure in brine and water; and synthetic minerals as potentially superior. A new look in high-level waste management, including waste form technology, is expected. 10 figures.

52683 (NUREG/CP—0005) **High-level radioactive solid waste forms.** Casey, L.A. (ed.). (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards). 1978. 763p. (CONF-781241—). Q 99/MF A01.

From Conference on high-level radioactive solid waste; Denver, CO, USA (19 Dec 1978).

Three concurrent workshops were held at this conference relating to the following open discussions: the ability of regulators to establish and to adhere to sufficiently meaningful criteria of solids to achieve safe regulation in high level waste disposal; the ability and likelihood of learning the characteristics of alternative waste forms and utilizing these in the choice of the optimum form for actual disposal; and system analyses which are used to predict long-term performance in waste disposal have led to a dominant reliance upon geologic retention, but an insignificant reliance upon the past emplacement durability of the waste solids. This discussion was whether basic reliance is wisely placed upon such predictions or whether, alternatively, the durability of solids has importance beyond transportation and retrievability.

52684 (NUREG/CP—0005, pp 41-79) **Physical properties of waste glass.** Mendel, J.E. (Battelle Pacific Northwest Lab., Richland, WA); Ross, W.A.; Turcotte, R.P.; McElroy, J.L. 1978.

From Conference on high-level radioactive solid waste; Denver, CO, USA (19 Dec 1978).

The physical properties of borosilicate glass make it a suitable waste form for the storage and disposal of high-level radioactive wastes. Waste glass has excellent radiation stability. As the result of over 10 years of testing it is known that the physical properties are relatively unaffected by high doses of contained radioactivity. Similar detailed studies have shown that the effects of self-heating in canisters of properly-formulated waste glass are also relatively minor. Glass is only one of a number of potentially satisfactory waste forms. It differs from the other waste forms mainly in that its processing has been developed to the point that a waste glass production plant is now operating in France. Using the known properties of waste glass as a baseline for comparison, important factors in the evaluation of alternate waste forms can be delineated. Among the factors that enter into the evaluation are: ability to deal with changing waste compositions, process complexity, waste loading, canister interactions, thermal stability, radiation stability, transmutation effects, and leachability. 8 figures, 6 tables.

52685 (NUREG/CR—0644) **Geotechnical analysis of soil samples from test trench at Western New York Nuclear Service Center, West Valley, New York.** Fickies, R.H.; Fakundiny, R.H.; Mosley, E.T. (New York State Geological Survey, Albany (USA)). Apr 1979. 31p. (NYSGS—79-2401). P 03/MF A01.

In July 1977, a deep research trench was excavated and soil samples collected at the Western New York Nuclear Services Center, West Valley, NY. The glacial till horizons sampled are considered to be representative of the till serving as a burial medium at the nearby low-level radioactive waste burial ground. A series of laboratory tests were conducted consisting of unit weight, moisture content, Atterberg limits, unconfined compression, dispersion, swell, permeability, and consolidation. These laboratory analyses and field observations indicate that the till exposed in the research trench is a generally dense mixture of silt and clay of low to medium plasticity, with minor amounts of fine to coarse sand and fine gravel. The till has a generally low coefficient of permeability in the range of 10^{-7} cm/s horizontal and 10^{-8} cm/s vertical. A network of vertical fractures exists in the upper 15 feet of weathered till which may allow some downward percolation of surface runoff. The test data indicates that the maximum depth to which these fractures could possibly penetrate is 50 feet.

52686 (ONWI—12) **Economics of national waste terminal storage.** (TRW, Inc., McLean, VA (USA). Energy Systems Group). Feb 1979. Contract EY-76-C-06-1830. 69p. Dep. NTIS, PC A04/MF A01.

This topical report integrates two separate studies performed in FY 1978: spent fuel pricing studies which have previously been reported in Y/OWI/SUB-78/42512/2, and cost analysis studies reported in Y/OWI/SUB-78/42512/1. The cost analysis studies, which are parametric in nature, have been used to generate pricing estimates using the methodologies developed for the pricing studies. 8 figures, 16 tables.

52687 (ORNL/TM—6921) **Hydraulic fracturing as a method for the disposal of volatile radioactive wastes.** Shaffer, J.H.; Blomeke, J.O. (Oak Ridge National Lab., TN (USA)). Aug 1979. Contract W-7405-ENG-26. 21p. P 02/MF A01.

This report proposed the further development of the hydrofracture process at the Oak Ridge National Laboratory for the permanent disposal of volatile radioactive wastes. The assessment of this method has included the disposal of ^{129}I, ^{14}C, ^{85}Kr, and tritium. It is recommended that additional studies be made of the feasibility of injecting krypton, as an admixture with xenon, directly into the hydrofracture grout stream for disposal in deep, impermeable shale formations. The annual production of ^{85}Kr from reprocessing 1500 metric tons of fuel would create a void of $\leqq 1\%$ when injected into the grout mixture used in a typical hydrofracture operation.

52688 (PB—289947) **State of geological knowledge regarding potential transport of high-level radioactive waste from deep continental repositories.** Giletti, B.; Siever, R.; Handin, J.; Lyons, J.; Pinder, G. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Jun 1978. Contract EPA-68-01-4470. 57p. Y A04/MF A01.

The report contains an evaluation of the state of knowledge in the earth sciences relevant to environmental aspects of the disposal of high-level radioactive wastes, by deep burial on the continents. A consideration must be given a time scale of hundreds of thousands to a few million years, but special attention must be given to the dangers of leakage over shorter terms up to a thousand years, when the levels of radioactivity are highest. A basic problem in storage of radioactive wastes stems from the addition of radioactive heat to the normal geothermal temperatures at depths on the order of 500 meters. Storage should be in an area that is subject neither to frequent, high-energy earth quakes nor to volcanic eruptions. A rock environment is required that is sealable and has a minimal permeability for fluids and radionuclides that might become dissolved in them. The most suitable rocks seem to be salt, shale, basalt, and certain granitic rocks, but some anhydrite and impereable tuffs should be considered.

52689 (PNL—2921) **Characterization of the Hanford 300 Area Burial Grounds. Task III: fluid transport and modeling.** Gee, G.W.; Simmons, C.S. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1979. Contract EY-76-C-06-1830. 126p. P 07/MF A01.

In Task III, Fluid Transport and Modeling, a computer model was developed and applied to the 300 Area Burial Grounds to analyze the influence of potential evaporation and rainfall patterns on drainage. The model describes one-dimensional unsaturated flow. Fluid transport equations were evaluated to describe the driving forces of fluid flow. The data indicate that the major processes are evaporative drying, capillarity, and gravity flow. Thermally induced transport does not appear significant in the subsurface sediments of the area. Several empirical evaporation methods are available for assessing potential evaporation/evapotranspiration. Four methods were used with the unsaturated flow model. Ultimately, the Blaney-Criddle method was chosen for subsequent simulation examples because it relies only on the climatic data available and gave results comparable to the other methods tested. Simulations showed that a dry layer formation is important in controlling the soil-water balance in the profile. The surface dry layer acts as a mulch to retard the evaporative water losses and increase water storage. The most important climatic factor in determining drainage appears to be yearly rainfall distribution. When rainfall is distributed in fall or winter, during periods of low potential evaporation, both water storage and drainage are increased. Summer showers, on the other hand, were shown to add little to the annual water storage. Rainfall occurring in one year influences the subsequent annual drainage for several succeeding years because of annual changes in water storage capacity and the transient nature of unsaturated flow in the storage zone. 47 figures, 9 tables.

52690 (RHO-BWI—79-100-2Q) **Basalt waste isolation program. Quarterly report, January 1, 1979—March 31, 1979.** Deju, R.A. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Apr 1979. Contract EY-77-C-06-1030. 49p. P 03/MF A01.

During the quarter, progress was made in all areas of the Basalt Waste Isolation Program. In the Geosciences, Hydrology, and Engineered Barriers areas, work continued on schedule aimed at being able to make a site selection decision in 1981, as scheduled.

Emphasis continued to be placed on geologic mapping studies, on hydrologic data gathering, and on definitions of waste/basalt interactions and needed engineered barriers. Construction of the Near-Surface Test Facility was rescheduled to reflect tunnel design changes and previous quarter work delays. Progress at the end of the quarter was approximately on schedule and the rate of work was accelerating to better than scheduled due to some equipment improvements and tunnel design modifications. In the Engineering Testing area, design work, test planning, and fabrication of heaters and auxiliary equipment continued on schedule. In the Repository area, an Architect/Engineer Evaluation Board was formally designated by the US Department of Energy-Headquarters during October 1978. The evaluation board will select an architect/engineer for repository conceptual design with an option for follow-on Title I, Title II, and Title III engineering services. Selection will be completed by October 1979. Questionnaire information was received from a number of interested architect/engineer firms by the US Department of Energy-Richland Operations Office and has been evaluated. Onsite visits with the qualified firms are scheduled during April 1979. In addition, repository preconceptual design studies continued on schedule with emphasis on compilation of repository functional design criteria by July 1979, and the repository preconceptual design report in August 1979. Twenty-nine documents were issued during the quarter. These documents are listed at the end of this report.

52691 (RHO-BWI-C—32) **Numerical modeling of rock stresses within a basaltic nuclear waste repository. Final report.** Hardy, M.P.; Hocking, G. (Minnesota Univ., Minneapolis (USA). Dept. of Civil and Mineral Engineering; Dames and Moore, Burlington, MA (USA)). 1 Oct 1978. Contract EY-77-C-06-1030. 283p. P 13/MF A01.

The modeling undertaken during this project incorporated a wide range of problems that impact the design of the waste repository. Interaction of groundwater, heat and stress were considered on a regional scale, whereas on the room and canister scale thermomechanical analyses were undertaken. In the Phase II report, preliminary guidelines for waste densities were established based primarily on short-term stress criteria required to maintain stability during the retrievability period. Additional analyses are required to evaluate the effect of joints, borehole linings, room support and ventilation on these preliminary waste loading densities. The regional analyses did not indicate any adverse effect that could control the allowable waste loading densities. However, further refinements of geologic structure, hydrologic models, seismicity and possible induced seismicity are required before firm estimates of the loading densities can be made.

52692 (RHO-CD—132(Rev.3)) **Basalt Waste Isolation Program Plan.** (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). 15 May 1979. Contract EY-77-C-06-1030. 150p. P 07/MF A01.

The Basalt Waste Isolation Program covers all activities necessary to assess the feasibility and provide the technology needed to design and construct a basalt waste repository within the Columbia Plateau. Individual chapters in this report are devoted to program description, summary program schedule, resource requirements, and management and control.

52693 (RHO-LD—79-83-1Q) **Commercial Waste and Spent Fuel Packaging Program. Quarterly technical progress report, October-December 1978.** (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Mar 1979. Contract EY-77-C-06-1030. 16p. P 02/MF A01.

Objective is to develop waste packages for geologic storage or disposal. This is the first quarterly progress report since the two separate programs were combined and assigned to ONWI. A drywell radial temperature profile is given. (DLC)

52694 (RHO-LD—79-83-2Q) **Commercial Waste and Spent Fuel Packaging Program. Quarterly technical progress report, January-March 1979.** (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Apr 1979. Contract EY-77-C-06-1030. 18p. P 02/MF A01.

The Conceptual Design Study for a Dry Well Facility was completed. In support of a dry surface demonstration, the first characterized PWR spent fuel assembly was encapsulated and placed in a sealed storage cask (SSC) concrete shield on December 15, 1978. This was the first of several dry surface demonstrations planned, and validated the encapsulation process. Data are now being collected to demonstrate dry surface storage concepts and the design, fabrication, packaging, and performance of spent fuel under surface storage conditions. Studies and results to date indicate that the dry well storage concept is preferable to the SSC for dry surface storage of spent fuel.

52695 (RHO-ST—14) **High-level waste leakage from the 241-T-106 tank at Hanford.** Routson, R.C.; Price, W.H.; Brown, D.J.; Fecht, K.R. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Feb 1979. Contract EY-77-C-06-1030. 313p. P 14/MF A01.

The history, status, fate, and impact of the 4.34 x 10^5-liter (115,000-gal) radioactive waste tank leak from the 241-T-106 tank have been studied since 1973. As of May 1978, the maximum detected depth of the 1-microcurie per liter (μCi/l) concentration of ^{106}Ru penetration was 33 meters (108 ft) below the ground surface or 29 meters (95 ft) above the regional water table. This maximum depth of penetration was detected in two of the dry wells in the 241-T tank farm. In no other well has radioactivity greater than 1.0-μCi/l been found deeper than 29 meters (95 ft). This is approximately 43% of the distance from the bottom of the tank to the water table. The maximum horizontal movement of the 1-μCi/l ^{106}Ru concentration front from the tank was approximately 23 meters (75 ft) at a depth of 25 meters (82 ft). This distance is approximately equal to the diameter of the tank. The rate of frontal movement of radioactivity was qualitatively estimated. A large portion of the movement occurred in 1973, prior to the publication of an initial tank leak status report. From 1973 to 1974, detectable lateral movement occurred in at least some sediment layers. From 1974 to 1978, movement could not generally be detected. However, migration in wells near the leak perimeter was detected in 1978, and the probable cause defined. Calculations on vadose zone moisture and wetting frontal movement were found to be essentially in qualitative agreement in their assessed lack of movement of any waste above concentration guidelines to the Hanford ground water. Thus, during the hazardous lifetime of the fission products, there will likely be no amount of radioactivity enter the Hanford ground water. Therefore, there appears to be no impact of the leak on the Columbia River (the nearest point of uncontrolled access).

52696 (RHO-ST—21) **Report on plutonium mining activities at 216-Z-9 enclosed trench.** Ludowise, J.D. (comp.). (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Sep 1978. Contract EY-77-C-06-1030. 77p. P 05/MF A01.

This report is divided into three major sections. The first section describes the 216-Z-9 enclosed trench prior to the mining operation. An overall history of the enclosed trench is presented with nuclear reactivity evaluations of the soil. The second section discusses the mining phase of the enclosed trench. Descriptions of the mining equipment and mining operations are contained in this section as well as statistics and problems encountered in the operations. This section concludes with reports on post mining phase operations: the monitoring of radiolytically produced gases and the retrofit program to make Z-9 drums safe for 20-year retrievable storage. The final section summarizes what was learned in doing the program.

52697 (SAND—79-0462) **Measurement of water lost from heated geologic salt.** Hohlfelder, J.J. (Sandia Labs., Albuquerque, NM (USA)). Jul 1979. Contract EY-76-C-04-0789. 22p. P 02/MF A01.

This report describes three methods used to measure the rate at which water is lost from heated geologic salt. The three methods were employed in each of a series of proof tests which were performed to evaluate instrumentation designed to measure the water-loss rate. It was found that the water lost from heated, 1-kg salt specimens which were measured according to these three methods was consistent to within an average 9 percent.

52698 (SAND—79-0745) **Preliminary results report: Conasauga near-surface heater experiment.** Krumhansl, J.L. (Sandia Labs., Albuquerque, NM (USA)). Jun 1979. Contract EY-76-C-04-0789. 67p. P 04/MF A01.

From November 1977 to August 1978, two near-surface heater experiments were operated in two somewhat different stratigraphic sequences within the Conasauga formation which consist predominantly of shale. Specific phenomena investigated were the thermal and mechanical responses of the formation to an applied heat load, as well as the mineralogical changes induced by heating. Objective was to provide a minimal integrated field and laboratory study that would supply a data base which could be used in planning more expensive and complex vault-type experiments in other localities. The experiments were operated with heater power levels of between 6 and 8 kW for heater mid-plane temperatures of 385°C. The temperature fields within the shale were measured and analysis is in progress. Steady state conditions were achieved within 90 days. Conduction appears to be the principal mechanism of heat transport through the formation. Limited mechanical response measurements consisting of vertical displacement and stress data indicate general agreement with predictions. Posttest data, collection of which await experiment shutdown and cooling of the formation, include the mineralogy of posttest cores, posttest transmissivity measurements and corrosion data on metallurgical samples.

52699 (SAND—79-1239) **Retrieval of canistered experimental waste at the waste isolation pilot plant.** Stinebaugh, R.E. (Sandia Labs., Albuquerque, NM (USA)). Jul 1979. Contract EY-76-C-04-0789. 40p. P 03/MF A01.

To assess the suitability of bedded salt for nuclear waste disposal, an extensive experimental program will be implemented at the Waste Isolation Pilot Plant. In order to evaluate experimental results, it will be necessary to recover certain of these experiments for postmortem examination and analysis. This document describes the equipment and procedures used to effect recovery of one category of WIPP experiments.

52700 (UCRL—15070) **Recharge and repressurization of a bedded salt depository.** Parr, J.T. (Analytic Sciences Corp., Reading, MA (USA)). 20 Jul 1979. Contract W-7405-ENG-48. 20p. P 02/MF A01.

A study of depository recharge and repressurization has been reviewed. Specific consideration has been given to the validity of two initial assumptions in that study. The first was a decision to ignore lateral flow and end effects into the depository. The second was a decision to ignore thermal effects. The review has been made with particular concern to assessing the sufficiency of the Golder model for estimation of worst-case (minimum) recharge-repressurization time (RRT) in a bedded salt depository. It has been concluded that several errors by Golder may have little net effect on this worst case scenario. Combination of lateral flow and thermal effects may, however, reduce the value of the Golder model for estimation of minimum RRT in a bedded salt facility. Several subjects for further model development are suggested, though the availability of data to support such models is not addressed.

52701 (UCRL—82284) **Geological disposal investigations in granite at the Nevada test site.** Ballou, L.B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 31 Jan 1979. Contract W-7405-ENG-48. 5p. (CONF-790304—7). P 02/MF A01.

From 19. annual ASME symposium, geological disposal of nuclear waste; Albuquerque, NM, USA (15 Mar 1979).

The Climax stock at NTS was the site of weapons effects tests and is to be used for radwaste disposal studies. The layout of Climax and proposed experiments is illustrated. Geology of Climax is described briefly. Thermal tests showed the thermal conductivity to be essentially isotropic, only slightly temperature-dependent, and 3.0 W/m-°K. Permeability is less than 1 nanodarcy. Plans for a spent fuel storage test and for rock mechanics tests are described. (DLC)

52702 (USGS-OFR—79-760) **Inventory of clay-rich bedrock and metamorphic derivatives in eastern Nevada, excluding the Nevada Test Site.** Simpson, H.E.; Weir, J.W. Jr.; Woodward, L.A. (comps.). (Geological Survey, Denver, CO (USA)). 1979. Contract EW-78-I-08-1543. 238p. P 11/MF A01.

Six counties of eastern Nevada contain 36 localities that include areas of exposed clay-rich sedimentary bedrock, slightly to moderately metamorphosed derivatives of such rocks, or both. In each locality one or more of these kinds of rocks constitute one or more geologic units greater than 152 m (500 ft) in thickness and 0.8 km^2 (0.3 m^2) in area at the ground surface. The sedimentary and metamorphic rocks locally meet or exceed arbitrarily selected minimum conditions of lithology, thickness, and areal extent. These places are grouped into localities and may be deemed suitable for further investigation. The localities identified are in Clark, Elko, Eureka, Lincoln, Nye, and White Pine Counties. The types of clay-rich rocks that might be useful include claystone, siltstone, shale, and various mixtures of them, together with metamorphic derivatives which include argillite, metasiltstone, slate, phyllite, schist, and gneiss. The geologic units that contain such clay-rich rocks also commonly contain mixtures, interlayers, and lenses of sandstone, conglomerate, and limestone, and their metamorphic derivatives: quartzite, conglomerite, and marble. Initially, the principal areas in Nevada where clay-rich rocks more than 31 m (100 ft) thick are exposed at the ground surface were identified by searching published geologic literature. From those areas, localities that contain exposed clay-rich rocks more than 152 m (500 ft) thick and of more than 0.8 km^2 (0.3 mi^2) in areas were selected. For each locality a brief descriptive text was prepared. Seven factors that might be significant in selecting localities best suited for further investigation are summarized therein. The factors are: (1) geographic location, (2) land ownership, (3) accessibility, (4) proximity to population concentration, (5) geologic setting, (6) hydrologic setting, and (7) mineral-resource activity.

52703 **Analysis of disposal of uranium mill tailings in a mined out open pit.** Staub, W.P.; Triegel, E.K. (Oak Ridge National Lab., TN (USA)). pp 353-371 of Management, stabilisation and environmental impact of uranium mill tailings. Paris, France; OECD Nuclear Energy Agency (1978).

From Management, stabilization, and environmental impact of uranium mill trailings; Albuquerque, NM, USA (24 Jul 1978).

Mined out open pits are presently under consideration as disposal sites for uranium mill tailings. In this method of tailings management, the escape of contaminated liquid into an adjacent aquifer is the principal environmental concern. The modified Bishop Method was used to analyze the structural stability of a clay liner along the highwall and fluid flow models were used to analyze the effect of tailings solutions on ground water under several operating conditions. Results of the slope stability analysis showed that it would be necessary to construct the clay liner as a modified form of engineered embankment. This embankment would be similar in construction to that of an earthfill dam. It could be constructed on a 1:1 slope provided the tailings slurry were managed properly. It would be necessary to maintain the freeboard height between the embankment and tailings at less than 4 m. A partially dewatered sand beach would have to be located adjacent to the embankmert. Potential leakage and aquifer contamination was modeled for lined and unlined pits of various designs. Sulfate, and possibly U and Th, are the most likely contaminants. Results from the model showed the clay and soil cement lined pit to be most effective in containing the pollutants.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 52613, 52671, 52688, 52689, 52709, 53649, 53650, 53657

52704 (DOE/EDP—0058) **Environmental Development Plan: uranium mining, milling, and conversion.** (Department of Energy, Washington, DC (USA)). Aug 1979. 173p. P 08/MF A01.

This Environmental Development Plan (EDP) identifies the planning and management requirements and schedules needed to evaluate and assess the environmental, health, and safety (EH and S) aspects of the uranium mining, milling, and conversion technologies. The plan represents the collective perceptions of EH and S concerns and requirements and knowledge of ongoing research programs of most of the Federal agencies involved in significant EH and S R and D program management, standards setting, or regulatory activities associated with uranium mining, milling, and conversion.

52705 (DOE/EV—0005/15) **Formerly utilized MED/AEC sites Remedial Action Program: radiological survey of the Bayo Canyon, Los Alamos, New Mexico. Final report.** Mayfield, D.L.; Stoker, A.K.; Ahlquist, A.J. (comps.). (Los Alamos Scientific Lab., NM (USA)). Jun 1979. Contract W-7405-ENG-36. 125p. P 06/MF A01.

A portion of Bayo Canyon, located in Los Alamos County in north-central New Mexico, was used between 1944 and 1961 as a site for experiments employing conventional high explosives in conjunction with research on nuclear weapons development. Radiochemistry operations conducted at the site resulted in the generation of liquid and solid radioactive wastes, which were disposed into subsurface pits and leaching fields. The site was decommissioned by 1963. The resurvey utilized information from a number of routine and special environmental surveillance studies as well as extensive new instrumental measurements, soil sampling, and radiochemical analyses. Results showed that residual surface contamination due to ^{90}Sr averaged about 1.4 pCi/g or approximately 3 times the level attributable to worldwide fallout. Surface uranium averaged about 4.9 μg/g or about 1.5 times the amount naturally present in the volcanic-derived soils of the area. Subsurface contamination associated with the former waste disposal locations is largely confined within a total area of about 10,000 m^2 and down to depths of about 5 m. Of 378 subsurface samples, fewer than 12% exceeded 13 pCi/g of gross beta activity, which is comparable to the upper range of activities for uncontaminated local soils. Health physics interpretation of the data indicates that the present population of Los Alamos living on mesas adjacent to Bayo Canyon is not receiving any incremental radiation doses due to the residual contamination. Potential future land uses of Bayo Canyon include development of a residential area.

52706 (RHO-BWI-CD—31) **Hanford site as it relates to an alternative site for the Waste Isolation Pilot Plant: an environmental description.** Fecht, K.R. (ed.). (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). Dec 1978. Contract EY-77-C-06-1030. 157p. P 08/MF A01.

The use of basalt at Hanford as an alternative for the Waste Isolation Pilot Plant (WIPP) would require that the present Basalt Waste Isolation Program (BWIP) at Hanford be expanded to incorporate the planned WIPP functions, namely the permanent storage of transuranic (TRU) wastes. This report discusses: program costs, demography, ecology, climatology, physiography, hydrology, geology, seismology, and historical and archeological sites. (DLC)

52707 (UCID—18240) **Leaching characteristics of actinides from simulated reactor waste glass.** Weed, H.C.; Coles, D.G.; Bradley, D.J.; Mensing, R.W.; Schweiger, J.S.; Rego, J.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.; Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1979. Contract W-7405-ENG-48. 14p. P 02/MF A01.

Even without statistical analysis, some general trends can be seen in the results: leach rate increases with flow rate at high temperature, but is approximately independent of it at room temperature; agreement between the results from the one-pass method and those from the IAEA method are fair in the case of WIPP brine

solution, and good in the case of the others; and the ^{237}Np leach rate increases with temperature, but the ^{239}Pu leach rate either decreases with temperature or does not change.

52708 Generic environmental impact statement on U.S. uranium milling industry. Martin, J.B.; Miller, H.J. (Nuclear Regulatory Commission, Washington, DC (USA)). pp 453-468 of Management, stabilization and environmental impact of uranium mill tailings. Paris, France; OECD Nuclear Energy Agency (1978).

From Management, stabilization, and environmental impact of uranium mill trailings; Albuquerque, NM, USA (24 Jul 1978).

The U.S. Nuclear Regulatory Commisson is preparing a generic environmental impact statement on the U.S. uranium milling industry to the year 2000. This document will lead to regulations covering management and disposal of mill tailings and make recommendations on what institutional arrangements are necessary for long-term isolation of the tailings waste. The basis for these regulations will be an evaluation of alternative tailings disposal programs. Each alternative is being considered from several perspectives, such as risks to maximum exposed individuals, population doses and health effects, susceptibility of sites to natural weathering forces, potential for groundwater impacts and costs.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 52659, 52673, 52695, 52704, 53285, 53286, 53651

52709 (TREE—1366) **Feasibility of using plants to decontaminate radioactive soils.** Chapin, J.A.; Cooper, C.S. (Idaho National Engineering Lab., Idaho Falls (USA)). Jul 1979. Contract FY-76-C-07-1570. 103p. P 06/MF A01.

This is a feasibility study that proposes the use of plants to remove radionuclides from soils. The approach taken was to (a) delineate methods that increase radionuclide uptake, (b) find climatically adapted plants that absorb the largest quantities of radionuclides, (c) develop cultural management practices that permit their optimum growth but do not allow contamination of air or of water tables, and (d) investigate plants that could be adapted to the Idaho National Engineering Laboratory climate under natural and greenhouse (controlled) conditions. The most significant finding of this study is the use of aquatic plants for soil decontamination. This technique appears to be feasible using plants such as water hyacinths, alligator weeds, water willows, or the common cattail, which can be grown in a greenhouse environment. The fact that aquatic plants can absorb heavy metals, such as mercury, cadmium, and lead, may be the most promising result of this study, as this may indicate a method for decontamination of mill tailings that contain other heavy metals, such as uranium, americium, and radium.

REGULATIONS

ACCOUNTABILITY AND SAFEGUARDS

REFER ALSO TO CITATION(S) 52645, 53248, 53568

52710 (ALO—0789-T5(Rev.)) **Integrated IAEA safeguards concepts for nuclear critical facilities.** (Sandia Labs., Albuquerque, NM (USA)). Aug 1979. Contract EY-76-C-04-0789. 19p. P 02/MF A01.

A study was undertaken to investigate concepts for international safeguards at critical facilities which would minimize impact on normal operations. Only high-inventory critical facilities were considered. A selection of possible system parameters was incorporated into 28 different international safeguards system concepts, one of which was identified for additional evaluation. If this system were implemented, it would involve methods of monitoring movement of materials and people and would maintain a running inventory that is tested periodically by independent inventory sampling. This monitoring would detect inventory and procedural discrepancies as well as unauthorized removal of nuclear materials. A special inventory may be taken following a monitoring alarm to confirm a suspected diversion. Comparison of various safeguards options led to the selection, for further development, of a system which uses a combination of surveillance and inspection by resident International Atomic Energy Agency (IAEA) personnel, containment/surveillance by unattended equipment, and periodic routine inventory verification. Evaluation techniques were used to establish that this system is likely to have a high probability of detecting the protracted diversion of a significant quantity of nuclear material. It was also established that practical containment and surveillance measures are necessary but may not be sufficient to achieve timely detection. However, due to current limitaions in evaluation methods for assessing containment and surveillance, overall system effectiveness was not quantified.

52711 (DOE/ET/01011—8) **On line computer recalibration of instruments. Final report, October 1, 1978-September 30, 1979.** Gilchrist, R.W.; Barnett, W.J. (Clemson Univ., SC (USA)). Jul 1979. Contract EY-77-S-09-1011. 136p. P 06/MF A01.

This report presents the results of work on the development of a system for on-line computer recalibration of instruments. The system consists of two computer programs: an off-line data analysis program and an on-line error reduction program. The off-line program accepts extensive calibration data, analyzes it and prepares it for use in the on-line program. The on-line program accepts the instrument observations and corrects for errors according to the current system state. The on-line program is appropriate for use with a microprocessor. Corrections are made for such deterministic errors as bias, linearity, and hysteresis and errors due to system state parameters such as temperature and humidity.

52712 (GEFR-SP—158) **Liquid weighing by buoyancy technique.** Jeter, D.W.; Hafer, D.E.; Hagie, L.T.; Kurtz, E.F. (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.). Apr 1979. Contract EN-77-C-03-1464. 50p. (CONF-790707—26). P 03/MF A01.

From 20. annual meeting of the Institute of Nuclear Materials Management; Albuquerque, NM, USA (16 Jul 1979).

A unique method is being developed to indirectly measure the mass of liquid in a tank. This method (the Bob Displacement Technique), which is based on Archimedes Buoyancy Principle, is described. The working equation is developed and reduced to a linear response equation which is unaffected by density. A prototype design for use on a plutonium/uranium nitrate feed tank has been developed and is described. The water testing of this hardware is discussed. Typical fuel cycle applications and the material accountability considerations are included.

52713 (LA—7784-MS) **Measurement of leached hulls.** Reilly, T.D. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 111p. P 06/MF A01.

Leached hulls are the short lengths of fuel rod cladding and fuel element hardware which constitute a major waste product of a reprocessing plant employing a chop-and-leach head-end process. The small, undissolved fuel residue (0.1 to 1.0% of original fuel content) which is discarded with this waste must be measured for safeguards, material accountability, and process control reasons. This report gives a critical analysis of hull measurement techniques involving the analysis of fission product gamma rays, spontaneous fission neutrons from curium, and delayed neutron activation. Major emphasis is given to the measurement of 2186-keV gamma rays from $^{144}Ce—^{144}Pr$. A detailed description of typical leached hull characteristics is presented at the beginning of the report. An extensive review of experience gained from existing hull measurement systems in the United Kingdom, France, Japan, Germany, Italy, and the United States is presented.

52714 (LA-UR—79-1821) **Survey of special nuclear material vehicle monitors for domestic and international safeguards.** Fehlau, P.E.; Atwater, H.F.; Caldwell, J.T.; Shunk, E.R. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 9p. (CONF-790707—24). P 02/MF A01.

From 20. annual meeting of the Institute of Nuclear Materials Management; Albuquerque, NM, USA (16 Jul 1979).

Special nuclear materials vehicle monitors, including gateside vehicle monitors, hand-held personnel-vehicle monitors, and a new tunnel monitor concept for very large vehicles, are discussed. The results of a comparison of effectiveness of monitors for domestic application are presented. The results of calculations and small scale prototype measurements are given for a tunnel-like neutron monitor for monitoring at the perimeter of an enrichment plant subjected to International Safeguards.

52715 (LA-UR—79-1843) **Selected nondestructive assay instrumentation for an international safeguards system at uranium enrichment plants.** Tape, J.W.; Baker, M.P.; Strittmatter, R.; Jain, M.; Evans, M.L. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 15p. (CONF-790707—28). P 02/MF A01.

From 20. annual meeting of the Institute of Nuclear Materials Management; Albuquerque, NM, USA (16 Jul 1979).

A selected set of nondestructive assay instruments for an international safeguards system at uranium enrichment plants is currently under development. These instruments are of three types: in-line enrichment meters for feed, product, and tails streams; area radiation monitors for direct detection of high-enriched uranium production, and an enrichment meter for spent alumina trap material. The current status of the development of each of these instruments is discussed, with supporting data, as well as the role each would play in a total international safeguards system. 5 figures.

52716 (NUREG/CR—0791) **Structured assessment analysis of Facility X. Volume I. Executive summary.** Parziale, A.A.; Sacks, I.J.; Rice, T.R.; Derbey, S.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.; Applied Decision Analysis, Inc., Menlo Park,

CA (USA)). 8 Jan 1979. Contract W-7405-ENG-48. 44p. (UCRL—52765). P 03/MF A01.

This report presents the results of the assessment of the Material Control and Accounting System of a typical facility for highly enriched nuclear fuel. The analysis of this facility was conducted using the Structured Assessment Approach developed at the Lawrence Livermore Laboratory under US Nuclear Regulatory Commission sponsorship. The analysis uncovered significant vulnerabilities within the Material Control and Accounting System to an insider threat.

52717 (NUREG/CR—0898) **Physical protection of nuclear facilities. Quarterly progress report, April-June 1979.** Chapman, L.D. (ed.). (Sandia Labs., Albuquerque, NM (USA)). Jul 1979. Contract EY-76-C-04-0789. 23p. (SAND—79-1281). P 02/MF A01.

Major activities included: (1) the vital area analyses of operating reactor facilities (both PWR and BWR); (2) assistance to NRC for evaluation of the Three Mile Island accident; (3) further development and testing of the ADPATH (adversary paths) subroutine for finding single-target theft and multiple-target sabotage paths in a facility; (4) the continued design and coding of COBOL and FORTRAN interfaces for the Safeguards Engineering and Analysis Data-Base (SEAD); (5) improvements to the Brief Adversary-Threat Loss-Estimator (BATLE) model, the Estimate of Adversary Sequence Interruption (EASI) Graphics model, and the Safeguards Network Analysis Procedure (SNAP); and (6) application of the Safeguards Automated Facility Evaluation (SAFE) methodology to several nuclear facilities.

52718 (SAND—79-0051) **Automated electronic intruder simulator for evaluation of odd frequency microwave detectors.** (Sandia Labs., Albuquerque, NM (USA)). Jan 1979. Contract EY-76-C-04-0789. 22p. P 02/MF A01.

A microwave intruder simulator for testing motion detection sensors is described. This simulator can be used to evaluate a variety of microwave sensors regardless of the value of the center frequency of the signal utilized. Representative curves from the evaluation of one microwave sensor are also presented.

52719 (UCID—18107) **Structural properties of the material control and accounting system.** (California Univ., Livermore (USA). Lawrence Livermore Lab.). Dec 1978. Contract W-7405-ENG-48. 34p. P 03/MF A01.

A unified digraph approach is proposed for the assessment of the structure of the MC & A System. The approach emphasizes the two structural aspects of the system: vulnerability and reliability. Vulnerability is defined as a possibility of loosing connectedness in a given structure due to line and/or node removals. It is purely deterministic notion which leads to a qualitative analysis of redundancy of connections in the corresponding system. Reliability of the MC & A System structure provides a more quantitative way of assessing how safe the system is to random failures of the links representing lines of communication, material paths, monitors, and the components of the power supply network. By assigning probabilities to the lines and nodes of the corresponding digraph, the least reliable path can be used as a measure of the goodness of the system, which can be computed by efficient shortest path algorithms. Both vulnerability and reliability considerations are important in determining the effect of tampering of an adversary with the elements of the MC & M System.

52720 (UCRL—52713) **Implementation study for the NRC Application and Development Facility.** Sherwood, R.J.; Ross, D.J.; Sasser, D.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 May 1979. Contract W-7405-ENG-48. 76p. P 05/MF A01.

The Nuclear Regulatory Commission (NRC) has expressed the desire to establish an Application and Development Facility (ADF) for NRC Headquarters. The ADF is a computer system which will provide safeguards analysts access to safeguards analysis computer software. This report analyzes the issues, requirements and options available in the establishment of an ADF. The purpose and goals of the ADF are presented, along with some general issues to be considered in the implementation of such a system. A phased approach for ADF implementation, which will allow for the earliest possible access to existing codes and also allow for future expansion, is outlined. Several options for central computers are discussed, along with the characteristics and approximate costs for each. The report concludes with recommended actions proposed to start the development of the ADF.

52721 (UCRL—82755) **Nondestructive, energy-dispersive, x-ray fluorescence analysis of actinide stream concentrations from reprocessed nuclear fuels.** Camp, D.C.; Ruhter, W.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 27 Jun 1979. Contract W-7405-ENG-48. 16p. (CONF-790756—1). P 02/MF A01.

From 28. annual Denver conference on applications of X-ray analysis; Denver, CO, USA (30 Jul 1979).

In one plan for reprocessing LWR spent fuel, after separation from fission products and transplutonics, part of the U and all of the Pu in a nitrate solution will form a coprocessed stream which is then evaporated and sent to a hold tank for accounting. The remaining U fraction will be purified and sent to a separate storage tank. These two streams can be monitored using x-ray fluorescence analysis. This report discusses equipment, spectra, cell calibration, and dynamic concentration measurements. 7 figures. (DLC)

FUSION FUELS

PROCESSING

FABRICATION AND TESTING

52722 (UCRL—81588(Rev.1)) **Fuel pellets and optical systems for inertially confined fusion.** Hendricks, C.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 May 1979. Contract W-7405-ENG-48. 9p. (CONF-790125—80(Rev.1)). P 02/MF A01.

From 1. topical meeting on fusion reactor materials; Miami Beach, FL, USA (29 Jan 1979).

Current laser-driven ICF targets are complex sets of concentric spherical shells made from a variety of materials including the fuel (e.g., deuterium-tritium), glass, beryllium, gold, polymeric materials, organo-metallics, and several additional organic and inorganic materials depending on the particular experiments to be done. While it is not yet known what the reactor targets will be exactly, there is little reason to believe they will be just simple, low quality glass shells containing DT gas or simple spheres of deuterated polyethylene or other fuel. Consequently, many of the current targets, materials, and fabrication techniques are considered to be applicable to the long range problems of ICF reactor target fabrication. Many current material problems and fabrication techniques are discussed and various quality factors are presented in an attempt to bring an awareness of the possible fusion reactor target materials problems to the scientific and technical community.

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

PHYSICAL ISOTOPE SEPARATION

52723 (COO—2961-3) **Photo-induced cataphoretic isotope separation. Progress report, June 15, 1978—June 15, 1979.** Carruthers, J.A. (Minnesota Univ., Minneapolis (USA)). Jun 1979. Contract EY-76-S-02-2961. 22p. P 02/MF A01.

The studies on radiation-induced cataphoretic isotope separation has been associated with the use of a 0.63-μ He:Ne laser as the radiation source in an attempt to obtain separation of ^{20}Ne and ^{22}Ne isotopes. A cataphoretic discharge tube containing mixed neon isotopes is within the laser resonator, whereas the laser tube contains only one neon isotope. Cataphoretic separation of the neon isotopes has not been observed, although selective excitation of one isotope has been demonstrated and a very sensitive technique for detecting cataphoretic isotope separation has been developed. Also, it is found that the exchange rate between the two neon isotopes in the excited laser levels is not great enough to significantly reduce the effect of selective excitation. Measurements of the current changes induced by the radiation indicate that the populations of those levels with which the laser radiation interacts is too small.

ISOTOPIC POWER SUPPLIES

DESIGN AND FABRICATION

52724 (DOE/ET/33008—1) **SIG Galileo final converter. Technical summary report.** Hinderman, J.D. (Minnesota Mining and Mfg. Co., St. Paul (USA). Electrical Products Group). May 1979. Contract EY-76-C-02-2331. 175p. P 08/MF A01.

The report summarizes significant events, activities and achievements on the SIG/Galileo Converter Program at 3M Company during the period June 1, 1978 through May 15, 1979. A stop work order was received from DOE on January 29, 1979 and all subsequent work and close out activities targeted for completion by May 15, 1979. Section A describes, in detail, the component configurations developed and proposed for the SN-1 converter. This converter was the Flight Design with the possible exception of N-leg improvements and a cold frame-housing interface processing change.

Included at the end of the converter description is the status of the design at the time of the stop work order. In Section B, the activities performed to accomplish the design goals are described as they occurred. Section C lists all pertinent documentation which was developed and issued relating to the design of the converter. This includes drawings, specifications, procedures and analysis. Operating requirements for the SN-1 converter are given.

52725 (DPST—78-128-11/12) **^{238}Pu fuel form processes. Bimonthly report, November/December 1978.** (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1978. Contract EY-76-C-09-0001. 27p. P 03/MF A01.

The report is one of a series to summarize progress in the Savannah River Laboratory ^{238}Pu Fuel Form Program. This program is supported by the DOE Division of Advanced Nuclear Systems and Projects (DANSP). Goals of the Savannah River Laboratory (SRL) program are to provide technical support for the transfer of DANSP ^{238}Pu fuel form fabrication operations from Mound Laboratory to new facilities at the Savannah River Plant (SRP), to provide the technical basis for ^{238}Pu scrap recovery at SRP, and to assist in sustaining plant operations.

52726 (LA—7980-PR) **General-purpose heat source project, space nuclear safety program, and radioisotopic terrestrial safety program. Progress report, June 1979.** Maraman, W.J. (comp.). (Los Alamos Scientific Lab., NM (USA)). Aug 1979. Contract W-7405-ENG-36. 47p. P 03/MF A01.

This formal monthly report covers the studies related to the use of $^{238}PuO_2$ in radioisotopic power systems carried out for the Advanced Nuclear Systems and Projects Division of the Los Alamos Scientific Laboratory. The three programs involved are the following: (1) general-purpose heat source development; (2) space nuclear safety; and (3) radioisotopic terrestrial safety.

PRODUCTION

REFER ALSO TO CITATION(S) 52421, 53383

STEAM REFORMER PROCESSES

REFER ALSO TO CITATION(S) 53383

OTHER SYNTHETIC AND NATURAL FUELS

PREPARATION

CHEMICAL SYNTHESIS

REFER ALSO TO CITATION(S) 52461, 52476

52727 (COO—4222-2) **Mechanistic studies related to the metal catalyzed reduction of carbon monoxide to hydrocarbons. Progress report, April 1, 1978-March 31, 1979.** Casey, C.P. (Wisconsin Univ., Madison (USA)). Dec 1978. Contract EG-77-S-02-4222. 13p. P 02/MF A01.

The stoichiometric reactions of metal complexes which parallel probable steps in the metal catalyzed reduction of CO are being investigated. Metal formyl complexes were studied which may be involved in the initiation step in CO reduction and metal formyl compounds were compared with metal acetyl compounds. It was found that the structure and kinetic stability of metal formyl compounds are very similar to metal acetyl compounds. However, metal formyl compounds are thermodynamically much less stable than metal acetyl compounds towards decarbonylation. Hydride donation reactions of metal formyl compounds were discovered. A neutral metal formyl compound was discovered and its reactions were investigated.

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 52798, 52799, 52803, 53360, 53468

52728 (ANL/EES-TM—53) **Environmental residuals and capital costs of energy recovery from municipal sludge and feedlot manure.** Ballou, S.W.; Dale, L.; Johnson, R.; Chambers, W.; Mittelhauser, H. (Argonne National Lab., IL (USA)). Aug 1978. Contract W-31-109-ENG-38. 35p. P 03/MF A01.

This report analyzes the capital and environmental cost of energy recovery from municipal sludge and feedlot manure. Literature on waste processing and energy conversion and interviews with manufacturers were used for baseline data for construction of theoretical models using three energy conversion processes: anaerobic digestion, incineration, and pyrolysis. Process characteristics, environmental impact data, and capital costs are presented in detail for each conversion system. The energy recovery systems described would probably be sited near large sources of sludge and manure, i.e., metropolitan sewage treatment plants and large feedlots in cattle-raising states. Although the systems would provide benefits in terms of waste disposal as well as energy production, they would also involve additional pollution of air and water. Analysis of potential siting patterns and pollution conflicts is needed before energy recovery systems using municipal sludge can be considered as feasible energy sources.

52729 (COO—2900-17(Vol.2)) **Fast production of methane by anaerobic digestion. Final report, May 24, 1976—December 31, 1978. Volume II. Appendices.** Finney, C.D.; Evans, R.S. II; Finney, K.A. (Natural Dynamics, Des Moines, IA (USA)). Dec 1978. Contract EY-76-C-02-2900. 177p. P 09/MF A01.

Appendix I is a compilation of the raw data taken during the work. Tables I-1 through I-11 contain data from the system consisting of digesters D_1, D_2, and D_3, and this was a major fraction of the study. Tables I-2 through I-5 pertain to thermophilic temperature experiments and Tables I-7 through I-9 and I-10 through I-11 pertain to agitational experiments. Table I-9A contains the data for the pressure experiment. Table I-1 is a collection of daily data that spans all of these studies, while Table I-6 is bridge between the temperature and agitational works. Tables I-12 and I-13 are a body of data taken on a second digestion system for a loading experiment conducted under the conditions of elevated temperature, reduced pressure, and vigorous agitation. Finally, Table I-14 includes data taken on a third laboratory system for anaerobically converting RDF to soluble COD. Appendix II is a procedure for correcting and converting the methane data in Table I-5 to gaseous COD.

52730 (LBL—9188) **Overview of biomass liquefaction.** Ergun, S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1979. Contract W-7405-ENG-48. 2p. (CONF-790638—1). P 02/MF A01.

From 3. annual biomass energy systems conference; Golden, CO, USA (5 Jun 1979).

The construction of a process development unit (PDU) at Albany, Oregon for converting biomass to oil was completed in December of 1976. The design of the facility was based on a process conceptualized by the Bureau of Mines in the early 1970s. The PDU was sized to produce oil at a rate of about five barrels per day. The background of liquefaction efforts and progress made at the Albany facility from January 1977 through September 1978 are discussed.

52731 (LBL—9189) **Direct liquefaction of biomass: correlative assessment of process development.** Figueroa, C.; Ergun, S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1979. Contract W-7405-ENG-48. 3p. (CONF-790638—3). P 02/MF A01.

From 3. annual biomass energy systems conference; Golden, CO, USA (5 Jun 1979).

A continual correlative assessment was made of process development activities at the wood-to-oil process development unit (PDU) located at Albany, Oregon, designed on the basis of bench scale batchwise experiments conducted at the Bureau of Mines. Studies were undertaken to fill the missing gaps in order to bring the biomass liquefaction program to a successful conclusion speedily.

52732 (PB—289775) **Preliminary environmental assessment of biomass conversion to synthetic fuels. Report for July—December 1976.** DiNovo, S.T.; Ballantyne, W.E.; Curran, L.M.; Baytos, W.C.; Duke, K.M. (Battelle Columbus Labs., OH (USA)). Oct 1978. Contract EPA-68-02-1323. 366p. Y A16/MF A01.

A preliminary evaluation of biomass production and conversion technologies, and their associated environmental consequences is presented. Five categories of biomass production were considered in detail. Thermochemical and biochemical technology were considered for conversion processes. Regionalized scenarios were prepared using commercial scale plants processing appropriate regionalized feedstock. Most processes use heterogeneous solid waste as a feed stock which are believed to pose more severe control requirements for emissions and effluents than other biomass feedstocks. The environmental and socio-economic effects of locating large conversion plants in rural environments need to be studied.

52733 (STUDSVIK/E—4-79/7) **Suitability of different gasification processes for energy production in Sweden.** Fornhammar, U.; Maijgren, B.; Kelen, T. (Studsvik Energiteknik AB, Nykoeping (Sweden)). 31 Jan 1979. 76p. (In Swedish). U 05/MF A01.

The suitability of different gasification processes for energy production in Sweden has been studied. Literature studies have been performed and different laboratories in USA, Germany, and Sweden working with gasification problems have been visited. The principles for a Swedish development program in the field of gasification of peat and biomass are given. In the future the development of commercial processes for biomass and peat is most important. At

present the work should be concentrated on the fluidized-bed technique.

52734 (TID—29398) **Anaerobic attached film expanded bed reactor for the treatment of dilute organic wastes.** Switzenbaum, M.S.; Jewell, W.J. (Cornell Univ., Ithaca, NY (USA). Dept. of Agricultural Engineering). Aug 1978. Contract EY-76-S-02-2981. 203p. P 10/MF A01.

The anaerobic attached film expanded bed reactor (AAFEB) has been found to be effective for the treatment of low strength soluble organic wastes anaerobically, at reduced temperatures, short retention times, and high organic loading rates. The process consists of inert particles, approximately 500 microns in apparent diameter, packed in a cylindrical column which expand slightly with the upward flow of liquid through the column. The AAFEB permits the maintenance of high solids retention times (SRT) values with low hydraulic retention times (HRT) values. Three reactors fed a soluble synthetic waste consisting of glucose and nutrient salts at concentrations ranging from 50 to 600 mg/1 COD were monitored over a period of nine months of start up and six months of operation. The effects of temperature, influent substrate concentration, and hydraulic flow rate on process efficiency were measured. Process efficiency was evaluated in terms of soluble COD removal and other parameters. In addition an organic carbon mass balance was evaluated to verify the experimental results. Biofilm thickness and biomass concentration were also measured. This study presents an analysis of the key process variables which affect AAFEB operation and presents two simplified first order equations relating the process efficiency to the net specific growth rate of the film and specific substrate utilization. The high effectiveness of this process is believed to be due to the large surface area to volume ratio created by the inert support media which enabled a large active mass of attached microorganisms to remain in the reactor at high liquid flow rates. Microbial mass concentrations exceeding 30 g/l were common in thisreactor. The rate limiting step in the overall process was the biochemical reactions and not mass transfer. A preliminary energy consumption comparison was made between the AAFEB and conventional aerobic treatment processes for the treatment of low strength organic wastewater.

52735 **Liquid hydrocarbon fuels from biomass.** Kuester, J.L. (Arizona State Univ., Tempe). Contract EY-76-S-02-2982. *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **24**: No. 2, 456-463(Mar 1979). (CONF-790415—P4).

From 177. national meeting of the American Chemical Society; Honolulu, HI, USA (1 Apr 1979).

Liquid fuel equivalents of existing commercial products can be produced by use of biomass feedstocks. Environmental problems are minimal. Process economics will become increasingly attractive as fossil fuels dwindle. If waste sources are utilized with a negative value, the economics are enhanced. Studies in progress should reveal the following: (1) effect of catalysts on pyrolysis gas composition and yield, and (2) product analysis and yields for various feedstocks. With success in these studies, the next logical step would seem to be to scale up to a larger system, e.g. 5 tons/day feedstock. 4 figures, 1 table.

52736 **Methane gas and plant nutrients from farm animal manure, a regional analysis.** Ostrovski, C.M.; Peters, N.; Sullivan, J.L. (Univ. of Western Ontario, London). pp 4.2.2.1-4.2.2.12 of Renewable alternatives. Volume 2. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

Methane gas and a good soil nutrient (fertludge) are produced from farm animal manure through the anaerobic digestion process. A systems analysis was carried out on a region identifying in particular the sensitive parameters that most affect the utilization of this process on a regional basis. Such parameters as manure availability and collectability, transportation, NPK value of the fertludge and cropland form part of the overall analysis. The model also accounts for qualitative factors such as odors, disease, water and air pollution that are associated with farm animal manure. The parameters analyzed are extremely important in view of resource and energy savings (methane gas, fertilizer) and environmental control (water and air). In many cases it is found that anaerobic digestion based on quantitative values is not economically profitable, but the increasing pressures for aesthetics, pollution and disease control make this process attractive. The model developed optimizes on the basis of least input and highest return.

CHEMICAL SYNTHESIS

REFER ALSO TO CITATION(S) 52461

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 52732, 53360

SOLID WASTE FUELS

REFER ALSO TO CITATION(S) 52728, 52799, 53280, 53281, 53358, 53359, 53360, 53413, 53546

HYDRO ENERGY

REFER ALSO TO CITATION(S) 53351, 53353

RESOURCES AND AVAILABILITY

REFER ALSO TO CITATION(S) 53062

REGULATIONS AND LICENSING

REFER ALSO TO CITATION(S) 53062

SOLAR ENERGY

REFER ALSO TO CITATION(S) 53354, 53355

52737 (CONF-7804121—(Absts.)) **International solar energy conference and fair.** (El Paso, City of, TX (USA); West Texas Council of Governments. Economic Development Agency). 1978. 29p. P 03/MF A01.

From International solar energy conference and fair; El Paso, TX, USA (13 Apr 1978).

This conference program contains general information, program schedule, floor plan of the meeting area, and synopses of selected presentations which are title listed. (MHR)

52738 (CONF-7804121—(Absts.), pp 13) **United States.** Goldberg, M.D. (Solar Energy Research Inst., Golden, CO). 1978.

From International solar energy conference and fair; El Paso, TX, USA (13 Apr 1978).

52739 (CONF-7804121—(Absts.), pp 13-14) **United Kingdom.** Page, J.K. (Univ. of Sheffield, England). 1978.

From International solar energy conference and fair; El Paso, TX, USA (13 Apr 1978).

52740 (CONF-7804121—(Absts.), pp 14) **France.** Robert, J. 1978.

From International solar energy conference and fair; El Paso, TX, USA (13 Apr 1978).

52741 (CONF-7804121—(Absts.), pp 15) **Israel.** Tabor, H. (Scientific Research Foundation, Jerusalem, Israel). 1978.

From International solar energy conference and fair; El Paso, TX, USA (13 Apr 1978).

52742 (CONF-7804121—(Absts.), pp 17) **Solar informaion explosion: getting at the useful knowledge.** Caton, D.L. (Univ. of New Mexico, Albuquerque). 1978.

From International solar energy conference and fair; El Paso, TX, USA (13 Apr 1978).

52743 (CONF-7804121—(Absts.), pp 21) **Methods of procurement and guides for proposal preparation.** Annan, R.H. 1978.

From International solar energy conference and fair; El Paso, TX, USA (13 Apr 1978).

52744 (SERI/PR—42-319) **Education Data Base semiannual report, October 1, 1978-March 31, 1979.** O'Connor, K. (Solar Energy Research Inst., Golden, CO (USA)). Jul 1979. Contract EG-77-C-01-4042. 24p. P 02/MF A01.

Progress is reviewed on the effort to establish a data base of all solar energy-related programs and courses currently being offered by the nation's post-secondary educational institutions. The National Solar Energy Education Directory, a 300-page listing of the solar course offerings at 700 institutions, was printed in March 1979. (MHR)

52745 (TAC-STPG—79-001) **Solar thermal power generation: a bibliography with abstracts. Quarterly update, January—March 1979.** (New Mexico Univ., Albuquerque (USA). Technology Application Center). Jun 1979. 103p. Univ. of New Mexico, Albuquerque.

This annotated bibliography contains citations on the following subjects: energy overviews; solar overviews; energy conservation; economics and law; solar thermal power; thermionic and ther-

moelectric; ocean thermal energy conversion; wind power; biomass and photochemical energy; and large scale photovoltaics. (MHR)

52746 Sun: mankind's future source of energy. Volume Two. de Winter, F.; Cox, M. (eds.). Elmsford, NY; Pergamon Press Inc. (1978). 805p. (CONF-780114—P2).

From International Solar Energy Congress; New Delhi, India (16 Jan 1978).

Separate abstracts were prepared for 134 of the papers presented. The remaining four papers were previously included in the data base. (WHK)

52747 Minimizing of heliostating problems (by special geometric fixing of mirrors). Varghese, C. pp 1357-1363 of Sun: mankind's future source of energy. Volume Two. de Winter, F.; Cox, M. (eds.). Elmsford, NY; Pergamon Press Inc. (1978).

From International Solar Energy Congress; New Delhi, India (16 Jan 1978).

For stimulating general public interest in some common solar energy problems, 4 teaching aids, simple enough for use in all schools and exhibitions even in the poorest countries, are proposed - for use with posters or such immediate-teaching arrangements. The subject is narrow in that it tries to examine direct-sunlight utilization only; but is broad in that it leaves the user to make up his own exact equations, (many factors mentioned here), mechanical designs, etc. to suit each unique circumstances.

RESOURCES AND AVAILABILITY

52748 (DOE/TIC—10139) **California solar data manual.** Berdahl, P.; Grether, D.; Martin, M.; Wahlig, M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1978. Contract W-7405-ENG-48. 302p. P 14/MF A01.

The factors that determined the data contents of the manual are presented. Estimates of errors in the data are provided, and the impact of these errors on solar design is discussed. The state was divided into 15 solar zones of roughly similar solar radiation conditions which are illustrated along with page references to the most relevant solar and climate data. A guide to the data tables and graphs is provided. Solar data, climate data, and climate charts are included. A guide to simplified design methods to predict the performance and cost of solar energy systems for the heating and cooling of buildings is provided. The nature of solar radiation as received at the surface of the earth is briefly summarized. The technique used to calculate unmeasured solar quantities, given measurements of other solar quantities is described. Included in appendices are: a solar radiation glossary, conversion factors between English and metric units, a general bibliography, and a supplementary list of specific references. (MHR)

52749 (SERI-TP—36-309) **Aerosols and solar energy.** Bird, R.E.; Hulstrom, R.L. (Solar Energy Research Inst., Golden, CO (USA)). 1979. Contract EG-77-C-01-4042. 11p. (CONF-7906108—1). P 02/MF A01.

From Workshop on artificial aerosols; Vail, CO, USA (19 Jun 1979).

A brief description is presented of the involvement of the Solar Energy Research Institute (SERI) in atmospheric research, including aerosol characterization and modeling. The use of both rigorous and simple models for radiation transport is described. Modeled broadband solar irradiance data are shown to illustrate the important influence that aerosols have on the energy available to solar systems and the economics of solar systems design. Standard aerosol measurement methods for solar applications are discussed along with the need for improved instrumentation and methods.

52750 Role of applied meteorology in the Canadian Energy Programme. McKay, D.C. (Atmospheric Environment Service, Downsview, Ontario). pp 2.3.2.1-2.3.2.13 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

This paper presents the various programmes being developed within the Atmospheric Environment Service with an indication of how these programmes will be beneficial both to the individual, who is responsible for providing design information to developers, and users of solar or wind driven apparati, and to the agency which is required to establish a regional monitoring network.

52751 Statistical analysis of solar radiation data in Montreal for solar energy utilization. Gueymard, C.; Labelle, D.; Bilgen, E.; Laframboise, F. (Ecole Polytechnique, Montreal, Quebec). pp 2.3.1.1-2.3.1.18 of Renewable alternatives. Volume 2. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

The published data of total and diffuse radiation, as well as sunshine duration, obtained at Jean Brebeuf station in Montreal, are the main elements for the followin analyses: (1) The mean variation of total, diffuse and direct radiation at short or long term, as well as the monthly distributions of total radiation on horizontal surface and fraction of possible sunshine are studied. (2) Correlations of the Angstrom type between sunshine duration and radiation are obtained. (3) The mean annual variation of insolation on vertical walls, compared to the horizontal one. These analysis should provide a better estimate of the solar energy potential in Montreal, either for high or low temperature applications.

ECONOMICS

REFER ALSO TO CITATION(S) 52762, 52766, 52774, 52785, 52787

52752 (CONF-7804121—(Absts.), pp 20) **Incentive and economics in solar energy applications.** Lumsdaine, E. (New Mexico Solar Energy Inst., Las Cruces). 1978.

From International solar energy conference and fair; El Paso, TX, USA (13 Apr 1978).

52753 (SERI—16) **Market penetration of solar energy: a model review workshop summary.** Schiffel, D.; Costello, D.; Posner, D.; Witholder, R. (Solar Energy Research Inst., Golden, CO (USA)). Jan 1978. Contract EG-77-C-01-4042. 85p. P 05/MF A01.

The proceedings of the workshop reviewing analytical models to project the market penetration of solar technologies are summarized. The workshop focused on comparisons with a model developed for the Department of Energy (DOE) by the MITRE Corporation, entitled Systems for Projecting the Utilization of Renewable Resources (SPURR). The objectives of the workshop are discussed, and a synopsis of formal workshop presentations are contained in the proceedings. Major strengths, weaknesses, and controversies of SPURR and other solar market penetration models are summarized. Conclusions concerning improvements in these models and their usefulness to decisionmakers are described.

52754 Utility rates and solar commercialization. Feurestein, R.J. *Sol. Law Rep.;* 1: No. 2, 305-368(Jul 1979).

Electricity is likely to be the most popular backup for solar heating, and cooling and hot water heating and for solar-produced electricity during periods of unfavorable weather. The rates at which that electricity is supplied will affect the economic feasibility of solar applications. The essential principle of rate regulation is that, in giving the utility a fair return on its investment, rates should reflect the cost of providing service. Some utilities claim that solar systems are expensive to serve, but studies have yielded conflicting results. Higher rates charged for solar backup service by some utilities have negative effects on solar system economics. Most utilities apply standard residential rates to solar backup, and some charge cheaper all-electric rates or low, experimental rates for service used to recharge storage units during offpeak periods. Rates affect solar system design and collector size. Solar users who think they are being discriminated against with higher rates have recourse to state (public utility commissions) and courts under state public utilities laws outlawing rate discrimination. The new Public Utility Regulatory Policies Act (part of the National Energy Act) encourages rate reforms which may be favorable to solar users, gives solar users greater rights to intervene in state rate proceedings, and guarantees wind generators and other solar electric producers backup power at fair rates. 283 references.

52755 Energy analysis of an aluminum solar collector. Ashton, W.; Robinson, J.E. (Univ. of Waterloo, Ontario). pp 1.1.4.1-1.1.4.9 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

From this energy analysis of an aluminum solar collector installed in New Brunswick Power's new office building in Shediac, N.B., it appears that the collector system uses almost as much energy in its manufactre and installation as it will produce in four years of its expected lifetime if the steel storage tank and particularly the aluminum are not recycled. On the contrary, if recycling of materials takes place, the collector will access substantially more energy than it consumes over a period of the first two years.

ENVIRONMENTAL, LEGAL, AND INSTITUTIONAL ASPECTS

REFER ALSO TO CITATION(S) 52796, 52797, 52885, 52886, 53356, 53357, 53702

52756 (CONF-7804121—(Absts.), pp 15) **Solar legislation, its scope and content.** Wade, H. (Arizona Solar Energy Research Commission, Phoenix). 1978.

From International solar energy conference and fair; El Paso, TX, USA (13 Apr 1978).

52757 (CONF-7804121—(Absts.), pp 16) **Role of educational and professional societies in the development of solar.** Brand, J. (Southern California Association, San Diego). 1978.

From International solar energy conference and fair; El Paso, TX, USA (13 Apr 1978).

52758 (CONF-7804121—(Absts.), pp 19) **Building rights and codes.** Eisenstadt, M. 1978.

From International solar energy conference and fair; El Paso, TX, USA (13 Apr 1978).

52759 (DOE/ERD—0019) **Environmental Readiness Document. Solar thermal power systems.** (Department of Energy, Washington, DC (USA)). Aug 1979. 36p. P 03/MF A01.

An Environmental Readiness Document is prepared at appropriate times in the development cycle of a technology program to inform decisionmakers of the present environmental status of an energy technology. The document addresses the uncertainties about environmental aspects of STPS that remain to be resolved through research and development. The resolution of these uncertainties may require adjustments in the technology program before it can be commercialized. The impacts and concerns presented in the document are treated generically without reference to specific predetermined sites unless these are known. Hence, specific site implications are not generally included in the assessment. The report contains two main section. One section highlights the characteristics of the technology, provides a status report on the technical and environmental R & D programs, presents a milestone chart representing a relationship between a considered commercialization schedule and relevant environmental R & D, and reviews the environmental concerns significant to the technology. Information pertinent to the technology R & D program was drawn from the technology program office and the current Environmental Development Plan. The other section examines the likelihood and consequences of adverse findings, the problems and uncertainties stemming from current or anticipated environmental regulation, and potential costs of environmental controls. On this basis, an assessment of the existing or potential barriers to commercialization is made.

52760 (NESEC—2) **Proceedings of a workshop on solar access legislation.** Wallenstein, A.R. (ed.). (Northeast Solar Energy Center, Cambridge, MA (USA)). Jul 1979. Contract EM-78-C-01-4274. 53p. P 04/MF A01.

With the growth of interest and participation by the consumer and the business community in solar energy utilization has come an awareness of potential or latent legal issues which could crop up concerning the protection of the right to access to the sun by owners of solar energy systems. A number of bills have been written which would protect solar access rights, and these bills raise substantial questions concerning the public policy to be pursued and the possible constitutional issues involved in the taking of property rights without just compensation. Consequently, in light of the increase in proposed solar access legislation, the Northeast Solar Energy Center held a workshop to explore the legal and legislative aspects of protecting sun rights, and to discuss the political and public impact of the legislation. The primary goals of the workshop were to determine (1) whether laws to protect solar access are, in fact, needed at this time, and (2) if needed, what are the best legal mechanisms for achieving the goals. The participants in the workshop, included representatives of the New England states, New York, New Jersey, and Pennsylvania, as well as individuals conversant with the solar access issue, such as those from the Environmental Law Institute, the American Planning Association, Solar Energy Industries Association, and lawyers, planners, and engineers. Condensations of the seven papers presented and the discussions are presented.

52761 (NESEC—3) **Product liability laws and their impact on solar energy development.** Hayward, J. (Northeast Solar Energy Center, Cambridge, MA (USA)). Jul 1979. Contract EM-78-C-01-4274. 43p. P 03/MF A01.

Recent federal actions in product liability are reviewed. Theories of liability are reviewed as follows: negligance, strict liability, express warranty, implied warranty, and deceit and misrepresentation. Product liability law of the northeast region is presented state by state: Connecticut, Maine, Massachusetts, New Hampshire, new Jersey, New York, Pennsyvania, Rhode Island, and Vermont.

52762 (SERI/TR—51-059) **Solar incentives planning and development: a state-of-the-art review and research agenda.** Schiffel, D.; Posner, D.; Hillhouse, K.; Doane, J.; Weis, P. (Solar Energy Research Inst., Golden, CO (USA)). Aug 1978. Contract EG-77-C-01-4042. 80p. P 05/MF A01.

A research agenda designed to assist the Department of Energy in the planning and development of solar energy incentives was developed. A four-element framework for assessing solar incentive policies is presented. In the context of this framework, the available solar research relevant to incentives for solar energy is reviewed. Comparing the requirements identified in the framework and the contents of completed research, major gaps in the literature on solar incentives are identified. An agenda for research is then proposed to eliminate these gaps and to provide information for constructing effective solar energy incentives.

52763 (SERI/TR—53-095) **Standards, building codes, and certification programs for solar technology applicatons.** Riley, J.D.; Odland, R.; Barker, H. (Solar Energy Research Inst., Golden, CO (USA)). Jul 1979. Contract EG-77-C-01-4042. 144p. P 07/MF A01.

This report is a primer on solar standards development. It explains the development of standards, building code provisions, and certification programs and their relationship to the emerging solar technologies. These areas are important in the commercialization of solar technology because they lead to the attainment of two goals: the development of an industry infrastructure and consumer confidence. Standards activities in the four phases of the commercialization process (applied research, development, introduction, and diffusion) are discussed in relation to institutional issues. Federal policies have been in operation for a number of years to accelerate the development process for solar technology. These policies are discussed in light of the Office of Management and Budget (OMB) Circular on federal interaction with the voluntary consensus system, and in light of current activities of DOE, HUD, and other interested federal agencies. The appendices cover areas of specific interest to different audiences: activities on the state and local level; and standards, building codes, and certification programs for specific technologies. In addition, a contract for the development of a model solar document let by DOE to a model consortium is excerpted in the Appendix.

52764 (SERI/TR—62-260) **Licensing arrangements and the development of the solar energy industry.** Green, M. (Solar Energy Research Inst., Golden, CO (USA)). Jun 1979. Contract EG-77-C-01-4042. 44p. P 03/MF A01.

The process by which technology and information related to technology are transferred within industry is explored. Property rights in technology are part of the broader field of intellectual property. The general contours of legal protection for knowledge are explored. The four basic forms of intellectual property-patents, trade secrets (or know-how), trademarks, and copyrights-are covered in varying degrees of depth, depending on their relative applicability to the development of the solar industry. Once this background has been estabilished, the legal aspects of licensing are examined. A license is a legal arrangement whereby a party (licensor) who controls the right to use an idea, invention, etc. shares the right to use the particular intellectual property with someone else (licensee). The advantages and disadvantages of licensing are described from the point of view of potential licensees and licensors. Barriers to licensing are discussed.

52765 (SERI/TR—62-266) **Problems in the administration of state solar legislation.** Warren, M. (Solar Energy Research Inst., Golden, CO (USA)). Jul 1979. Contract EG-77-C-01-4042. 48p. P 03/MF A01.

Solar legislation may 1) stimulate research and development, 2) encourage solar installation by governmental incentives, or 3) contribute to the elimination of institutional barriers. Legislation that attempts to deal with a wide range of problems will touch many different departments and agencies in state government. Proper administration is essential to the effectiveness of such legislation. The Federal Government is also involved in extensive programs to foster the commercialization of solar technology. The programs and standards that they evolve create another set of administrative rules and regulations that the solar manufacturer, seller, installer, or consumer has to face. This paper focuses on the experience of California, Oregon, and New Mexico, and suggests methods to avoid administrative difficulties that have slowed some solar initiatives. Several common problems are identified: inadequate definition of important terms, ineffective delegation of administrative responsibilities, and insufficient coordination with other state and federal solar programs.

52766 (SERI/TR—62-269) **Legal and institutional implications of providing financial incentives to encourage the development of solar technologies.** Hyatt, R.J. (Solar Energy Research Inst., Golden, CO (USA)). Jul 1979. Contract EG-77-C-01-4042. 64p. P 04/MF A01.

The legal basis to provide financial incentives is found in the enumerated powers of the Constitution for the exercise of federal authority, the police and tax powers for the exercise of state authority, and state delegated powers for the exercise of local authority. These powers are limited by the federal and state constitutions, and the scope of delegated authority. The major types of financial incentives are tax incentives, including income tax deductions and credits, accelerated depreciation allowances, tax-exempt bonds, and

reduction in property and sales taxes; loan incentives, including low interest loans, government guaranteed and insured loans, and elimination of statutory and secondary market constraints; and government transfer incentives, including grants in aid from all levels of government. Other incentives that will indirectly affect the financing and availability of solar energy technologies include eliminating or reducing financial incentives benefiting competitive energy sources, government action to insure the operation of solar energy equipment, government-sponsored education, research, and development programs, government demonstration and procurement programs, and placing priority on rapid passage of solar energy legislation dealing with financial incentives. In most cases, a financial incentives program constituting one or more of these incentives will probably not confront any major, unique, legal or institutional impediments. The minor impediments that do exist can usually be eliminated by preventive legislation.

52767 (SERI/TR—62-272) **Impact of the antitrust laws on the commercialization of solar heating and cooling.** Gross, J. (Solar Energy Research Inst., Golden, CO (USA)). Jun 1979. Contract EG-77-C-01-4042. 70p. P 04/MF A01.

Many energy industry observers and solar equipment producers view the commercialization of solar technologies as an opportunity to undermine the dominance now enjoyed by energy companies and electric utilities. Whether their hopes will be realized depends on Congress' posture towards interenergy diversification (which is currently permissive), DOE's spending practices (which have, in the past, been relatively insensitive to competitive consequences), and ultimately, the Supreme Court's willingness to aggressively enforce the antitrust laws (which is not unlikely, given recent holdings). Notwithstanding the legislative and administrative branches' tacit compliance with entrenched firms' involvement in the various solar energy submarkets, injured business persons and consumers (as well as the Department of Justice and the Federal Trade Commission) have the opportunity to force the controversy onto the judiciary by bringing suit under the antitrust laws against companies allegedly displaying anti-competitive market practices. The interchangeability between end uses of renewable and nonrenewable energy resources creates opportunities and motives for market manipulation. Consequently, the potential of energy firms for facilitating solar technology development (due to technological knowledge, managerial expertise and capital resources) must be weighed against the possibility that their involvement will, in the long run, retard development. 356 references.

52768 **Energy management through energy conservation in buildings.** Besant, R.W.; Schoenau, G.J.; Dumont, R.S. (Univ. of Saskatchewan, Saskatoon). pp 5.2.6.1-5.2.6.16 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

A review of the long term world and Canadian energy supplies and long term energy demands leads to the following inescapable conclusion: all legal jurisdictions in Canada must develop comprehensive energy management policies for large long term energy using investments; particularly, buildings. This policy is described.

52769 **Energy education training in solar energy technology and conservation.** Riordan, J.M. (J.M. Riordan and Associates, Toronto, Ontario). pp 8.1.4.1-8.1.4.13 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

The intent of this paper is to present a case for the introduction of solar energy educational programs specifically but not exclusively for post-secondary institutions. Canada's energy options are briefly reviewed and technologies appropriate to various options are inferred. The prospects for renewable energy technology will be considered by examining a variety of solar energy systems and potential applications of these systems, particularly by industry. The future of the solar energy industry in Canada, corporate involvement, and government impact on the industry will be examined in order to determine the advisability of developing programs in alternative forms of energy production. Employment prospects for graduates of, for example, a three-year solar energy technology program are discussed to illustrate the need for skilled technicians in the field. The potential benefits of general courses with a conserver orientation are also explored. The latter category is intended to include continuing education, evening classes, summer courses, and electives. A strategy for incorporating solar energy studies into existing curriculum is outlined.

52770 **Alternate energy education at Jordan College.** Coxon, D.A. (Jordan Coll., Cedar Springs, MI). pp 8.1.6.1-8.1.6.6 of Renewable alternatives. Volume 2. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

A review of the solar energy courses taught at Jordan College is given. (MOW)

52771 **Joint investigation by the Public Utilities Commission of the State of California and the Energy Ressources Conservation and Development Commission: availability and potential use of solar energy in California.** Sacramento, CA; California Energy Resource Conservation and Development Commission (1978). 24p. (NP—23871).

The California Public Utilities Commission (PUC) and the California Energy Commission (CED) issued a joint order instituting an investigation to determine and evaluate the solar energy activities of utilities and others for the purpose of adopting rules or appropriate orders to encourage and accelerate the development of solar energy. Joint findings and conclusions were filed by both Commission staffs. The only other filings were made by Pacific Gas and Electric Company (PG and E), San Diego Gas and Electric Company (SDG and E), Southern California Edison Company (SCE), and Southern California Gas Company (SoCal). The focus of evidence with respect to the technological issues presented in connection with this proceeding has been on-site thermal uses, particularly solar water heating and solar space conditioning. The second major subject area explored by this proceeding was the question concerning which programs and services should be provided by the private sector, the public utilities, and/or the government in order to promote the use of solar energy in the State of California. Specific findings and conclusions are set forth here.

SOLAR ENERGY CONVERSION

PHOTOVOLTAIC CONVERSION

REFER ALSO TO CITATION(S) 52820, 52904, 52966, 53254, 53460

52772 (COO—4094-46) **100 kW peak photovoltaic power system for the Natural Bridges National Monument.** Lyon, E.F. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 1979. Contract EY-76-C-02-4094. 5p. (CONF-790541—43). P 02/MF A01.

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The Department of Energy, in partnership with the National Park Service of the Department of the Interior, is sponsoring the implementation of 100 kW peak photovoltaic power system for the Natural Bridges National Monument in southeastern Utah. This remote site, which presently obtains all of its electrical energy from a diesel-powered generator, is manned year-round by NPS personnel. Starting in the fall of 1979, the PV system will begin to provide the bulk of the electrical demand at the site. Sunlight will be converted into dc electricity by an array field of glass-covered modules containing three types of silicon solar cells. The 1700 m^2 array, with over a quarter million two- and three-inch cells, will be the largest flat-plate PV field in the world at the time of its dedication. The power system will take dc power from the array, store excess energy in a 750 kWh lead-acid battery, and convert dc to ac in a single 50 kVA inverter. A standby diesel-powered generator will provide backup for the system in the event of extended inclement weather.

52773 (DOE/ET/23001—T1) **Development of high efficiency, low cost $ZnSiAs_2$ solar cells. Quarterly technical progress report No. 1, April 9, 1979-June 30, 1979.** Andrews, J.E. (Research Triangle Inst., Research Triangle Park, NC (USA)). 1979. Contract AC04-79ET23001. 7p. P 02/MF A01.

The purpose of this study is to continue an investigation of one of the chalcopyrite semiconductors ($ZnSiAs_2$) in order to assess its suitability as a solar cell material. $ZnSiAs_2$ was previously synthesized using an open tube vapor phase epitaxial growth technique, and epitaxial layers of $ZnSiAs_2$ were deposited on Ge and GaAs substrates (both (001) and (112) $ZnSiAs_2$ on (100) and (111) substrates, respectively). Epitaxial deposits were routinely achieved while the surface appearance varied from mirror-like to a dull appearance which resulted from a relatively rough surface topography. Mirror-like finishes were clearly an achievable goal but required additional refinements in growth technique and substrate preparation before they could be routinely achieved. Three critical goals have been identified that must be achieved before $ZnSiAs_2$ can be realistically assessed: (1) hole concentrations must be reduced from the current 10^{18} to $10^{19}/cm^3$ range to the 10^{16} to $10^{17}/cm^3$ range; (2) n-type $ZnSiAs_2$ must be demonstrated; and (3) $ZnSiAs_2$ p-n junctions must be demonstrated. The approach taken and the progress made toward achieving these goals as well as the planned effort for the next quarter are described.

52774 (DOE/JPL—1012-79/5(Vol.1)) **Normative price for a manufactured product: the SAMICS methodology. Volume I. Executive summary.** Chamberlain, R.G. (Jet Propulsion Lab., Pasadena,

CA (USA)). 15 Jan 1979. Contract EX-76-A-29-1012. 17p. (JPL-PUB—78-98(Vol.1)). P 02/MF A01.

The Solar Array Manufacturing Industry Costing Standards (SAMICS) provide standard formats, data, assumptions, and procedures for determining the price a hypothetical solar array manufacturer would have to be able to obtain in the market to realize a specified after-tax rate of return on equity for a specified level of production. This document summarizes the methodology and its theoretical background. It is contended that the model is sufficiently general to be used in any production-line manufacturing environment.

52775 (DOE/JPL/954328—10) **Development of accelerated test design for service-life prediction of solar array at Mead, Nebraska. Quarterly report.** Gaines, G.B.; Thomas, R.E.; Noel, G.T.; Shilliday, T.S.; Wood, V.E.; Carmichael, D.C. (Battelle Columbus Labs., OH (USA)). 3 Nov 1978. Contract NAS-7-100-954328. 28p. P 03/MF A01.

As a significant beginning in applying accelerated tests to solar arrays for life-prediction purposes, this study is directed toward (a) developing a plan for predicting the service life of a specific solar array in a specific geographic site - viz., the 25-KW flat-plate array installed near Mead, Nebraska, and (b) developing technical information from laboratory and field measurements for designing an accelerated test that can be carried out in 2 years and have predictive validity for a service life as long as 20 years. Status of the program is described.

52776 (DOE/JPL/954334—8) **Feasibility of low-cost, high-volume production of silane and pyrolysis of silane to semiconductor-grade silicon. Low cost silicon solar array project. Quarterly progress report for July—September 1978.** Breneman, W.C.; Farrier, E.G.; Morihara, H. (Union Carbide Corp., Tarrytown, NY (USA)). 1978. Contract NAS-7-100-954334. 84p. P 05/MF A01.

The project is divided into four tasks: silane production, silicon production, process design, and fluid-bed pyrolysis R and D. The purpose of the silane production task is to determine the feasibility and practicality of high-volume, low-cost production of silane (SiH_4) as an intermediate for obtaining solar-grade silicon metal. The process is based on the synthesis of SiH_4 by the catalytic disproportionation of chlorosilanes resulting from the reaction of hydrogen, metallurgical silicon, and silicon tetrachloride. The goal is to demonstrate the feasibility of a silane production cost of under $4.00/kg at a production rate of 1000 MT/year. The objective of the silicon production task is to establish the feasibility and cost of manufacturing semi-conductor grade polycrystalline silicon through the pyrolysis of silane (SiH_4). The silane-to-silicon conversion is to be investigated in a fluid bed reactor and in a free-space reactor. The process design task is to provide JPL with engineering and economic parameters for an experimental unit sized for 25 metric tons of silicon per year and a product-cost estimate for silicon produced on a scale of 1000 metric tons per year. The purpose of fluid-bed pyrolysis task is to explore the feasibility of using electrical capacitive heating to control the fluidized silicon-bed temperature during the heterogeneous decomposition of silane and to further explore the behavior of a fluid bed. These basic studies will form part of the information necessary to assess technical feasibility of the fluid-bed pyrolysis of silane. Status of these tasks are reported. (WHK)

52777 (DOE/JPL/955006—1) **LSA silicon material task closed-cycle process development. Quarterly report No. 1, August—September 1978.** Roques, R.A.; Wakefield, G.F.; Blocher, J.M. Jr.; Browning, M.F. (Texas Instruments, Inc., Dallas (USA)). Oct 1978. Contract NAS-7-100-955006. 26p. P 03/MF A01.

This program is Phase I of an effort to achieve production of low-cost solar grade polysilicon from metallurgical grade silicon in a closed cycle process. The impure silicon will be converted to trichlorosilane by reaction with by-product silicon tetrachloride, and the trichlorosilane thermally decomposed in a rotary drum reactor. The technical restrictions applied to development of the program approach were based on minimizing new technology requirements by evolving existing technology to reduce the timing, risk, and cost of achieving production capability. The deficiencies in the established Siemens polysilicon process were identified and systematically eliminated to achieve a simple, continuous, easily scalable, low-cost process. The process is closed cycle with high reactant concentration for material, equipment and energy efficiency. The initial effort to demonstrate the feasibility of the closed cycle process was begun with the design of the two major untested equipments: the silicon tetrachloride reactant-product converter and the rotary drum reactor (RDR) for deposition of silicon from trichlorosilane. The design criteria of the initial laboratory equipment included consideration of the reaction chemistry, thermodynamics, and other technical factors. Preliminary design of the laboratory equipment was completed and major parts for fabrication were placed on order. A preliminary solar grade polysilicon cost estimate of $6.91/kg supports the potential of this approach to achieve the cost goal. Program plan and evaluation criteria were submitted for JPL approval. A program milestone chart and baseline cost estimate were made and plans for th next quarter firmed up.

52778 (DOE/JPL/955089—10) **Silicon solar cell process development, fabrication and analysis. First quarterly report, June 15—September 30, 1978.** Yoo, H.I.; Iles, P.A.; Tanner, D.P. (Optical Coating Lab., Inc., City of Industry, CA (USA). Photoelectronics Div.). 1978. Contract NAS-7-100-955089. 120p. P 06/MF A01.

Solar cells were fabricated from unconventional silicon sheets (Wacker Silso wafers and EFG ribbon, RF furnace grown), and the performances were characterized with an emphasis on statistical evaluation. A number of solar cell fabrication processes were used, and conversion efficiency was measured under AMO condition at 25°C. Silso solar cells using standard processing showed an average efficiency of about 9.6%. Solar cells with back surface field (BSF) process showed about the same efficiency as the cells from standard process. Solar cells from grain boundary passivation process did not show any improvements in solar cell performance. These efficiency values are about 2% lower than those of the single-crystalline control solar cells of about the same resistivity. Solar cells (2 x 2 cm) from corners and edges of the original Silso wafer (10 x 10 cm) showed considerably lower efficiency than those of the cells from the middle part, mainly due to the difference in grain size, and this result agrees well with the result of the minority-carrier diffusion length and spectral response measurements. EFG solar cells (area about 506 cm^2) were fabricated using standard and BSF processes. Average efficiency of the standard and BSF solar cells was around 7.8% and 8.5%, respectively. This is about 1% lower efficiency than that of the Silso solar cells, due to lower curve-fill factor and open-circuit voltage, and was suspected to be due to shunting caused by silicon-carbided particles from die material. Minority-carrier diffusion length stayed about the same in both sheets, showing about 40 to 60 μm range.

52779 (DOE/JPL/955201—1) **Low cost solar array project: composition measurements by analytical photon catalysis. First quarterly report, November 1—December 31, 1978.** Sutton, D.G.; Galvan, L.; Melzer, J.; Heidner, R.F III. (Aerospace Corp., El Segundo, CA (USA). Ivan A. Getting Labs.). 1978. Contract NAS-7-100-955201. 25p. Dep. NTIS, PC A02/MF A01.

The object of this research is to assess the applicability of the photon catalysis technique for effecting composition analysis of silicon samples. In particular, the technique is to be evaluated as a detector for the impurities Al, Cr, Fe, Mn, Ti, V, Mo and Zr. During the first reporting period Al, Cr, Fe and Mn were detected with the photon catalysis method. The best fluorescence lines to monitor were established, and initial sensitivities to each to these elements were determined by atomic absorption calibration. In the course of these tests, vapor pressure curves for these four pure substances have also been mapped.

52780 (DSE—2460-5) **Improved semiconductors for photovoltaic cells. Quarterly report No. 5, July 1—September 30, 1977.** Catalano, A.W.; Cambridge, J.; Dalal, V. (Delaware Univ., Newark (USA). Inst. of Energy Conversion). 1977. Contract EX-76-C-01-2460. 40p. P 04/MF A01.

Materials work concentrated on attempts to develop the growth of sizeable, good quality Zn_3P_2 single crystals into a routine process. These attempts have been only partially successful. It was observed that the rate of material transport, under nominally identical conditions, varied from sample to sample. Since it had already been shown that this transport rate is very sensitive to the composition of the vapor during growth, we have arranged to control this composition by incorporating a small effusion hole in the wall of the growth ampoule to serve as a controlled leak. With this refinement reproducible transport rates have been achieved. Two problems remain to be solved before the growth process becomes routine. These are the formation of excess nuclei, which currently limits grain size, and strain which results upon cooling the crystal from its growth temperature to room temperature.

52781 (N—79-14546) **Concentrator enhanced solar arrays design study. Final report.** Lott, D.R. (Lockheed Missiles and Space Co., Palo Alto, CA (USA)). Oct 1978. Contracts NAS7-100;JPL-955110. 114p. Y A06/MF A01.

The analysis and preliminary design of a 25 kW concentrator enhanced lightweight flexible solar array are presented. The study was organized into five major tasks: (1) assessment and specification of design requirements; (2) mechanical design; (3) electric design; (4) concentrator design; and (5) cost projection. The tasks were conducted in an iterative manner so as to best derive a baseline design selection. The objectives of the study are discussed and comparative configurations and mass data on the SEP (Solar Electric Propulsion) array design, concentrator design options and configuration/mass data on the selected concentrator enhanced solar array baseline design are presented. Design requirements supporting design analysis and detailed baseline design data are discussed. The results of the cost projection analysis and new technology are also discussed.

52782 (N—79-14548) **Pilot line report: development of a high efficiency thin silicon solar cell.** (Solarex Corp., Rockville, MD (USA)). Nov 1978. Contracts NAS7-100;JPL-954883. 65p. Y A04/MF A01.

Experimental technology advances were implemented to increase the conversion efficiency of ultrathin 2cm x 2cm cells, to demonstrate a capability for fabricating such cells at a rate of 10,000 per month, and to fabricate 200 large-area ultrathin cells to determine their feasibility of manufacture. A production rate of 10,000 50 micron m cells per month with lot average AM0 efficiencies of 11.5% was demonstrated, with peak efficiencies of 13.5% obtained. Losses in most stages of the processing were minimized, the remaining exceptions being in the photolithography and metallization steps for front contact generation and breakage handling. The 5cm x 5cm cells were fabricated with a peak yield in excess of 40% for over 10% AM0 efficiency. Greater fabrication volume is needed to fully evaluate the expected yield and efficiency levels for large cells.

52783 (N—79-14551) **Conceptual approach study 200 watt per kilogram solar array, phase 3. Final report.** Rayl, G.J. (General Electric Co., Philadelphia, PA (USA). Space Div.). 30 Oct 1978. Contracts NAS7-100;JPL-954393. 51p. Y A04/MF A01.

Activities are described that were directed by JPL to support the earlier conceptual design work with proof of concept models on the one hand, and laboratory test and evaluation of alternate designs and materials that hold promise for further mass economies, on the other. In support of this advanced solar blanket technology the following work was accomplished: (1) preparation of an 80 cell solar module for a 1000 cycle thermal test (2) fabrication of a 660 cell solar panel and performance evaluation of this article after a '0' g flight test, (3) design improvement of the cell interconnect for further mass reduction, (4) completion of UV exposure and thermal cycle tests for a variety of cell cover material and adhesives and (5) preparation of a quantity of representative solar array test specimens for space flight on NASA's Long Duration Exposure Facility (LDEF).

52784 (N—79-14555) **Development of a model and computer code to describe solar grade silicon production processes. Quarterly report.** Gould, R.K. (Aerochem Research Labs., Inc., Princeton, NJ (USA)). Nov 1978. Contract JPL-954862. 13p. Y A02/MF A01.

Mechanisms for the $SiCl^4$/Na and SiF^4/Na reaction systems were examined. Reaction schemes which include 25 elementary reactions were formulated for each system and run to test the sensitivity of the computed concentration and temperature profiles to the values given estimated rate coefficients. It was found that, for $SiCl^4$/Na, the rate of production of free Si is largely mixing-limited for reasonable rate coefficient estimates. For the SiF^4/Na system the results indicate that the endothermicities of many of the reactions involved in producing Si from SiF^4/Na cause this system to be chemistry-limited rather than mixing-limited.

52785 (SAN—1101/PA8-9) **Pennies a day: financing early deployment of photovoltaic utility applications through a user subsidy.** Siegel, B. (Aerospace Corp., El Segundo, CA (USA). Energy and Transportation Div.). May 1978. Contract EY-76-C-03-1101-008. 37p. (ATR—78(7694-04)-2). P 03/MF A01.

Calculations indicate that the benefits of photovoltaic generation are unlikely to be soon realized unless the photovoltaic alternative is supported, as other energy technologies have been, by some sort of economic subsidy. This report describes the results of a preliminary investigation of one way of providing the required subsidy: simply allowing the utility company to recover the additional cost of photovoltaic generation through increases in charges to customers. As is shown, a very substantial early penetration of photovoltaic generation capacity into the generation mix of a utility system could be financed by quite modest increases in the annual electric bills of consumers. The analysis procedure used assumes a photovoltaic plant deployment rate and computes the total additional cost of electricity generation that would result from the deployment of the photovoltaic plants rather than of equivalent fossil-fuel plants. This additional annual cost is then apportioned, on a per kWh basis, among all utility customers, and the impact on the average residential customer's electric bill is determined.

52786 (SAN—1580-2) **Cadmium sulfide copper ternary heterojunction cell research. Annual report, September 30, 1977—September 30, 1978.** Fleming, D.L. (Sperry Univac, St. Paul, MN (USA)). Oct 1978. Contract EG-77-C-03-1580. 41p. P 03/MF A01.

Work on the first year of a project to develop the technology to produce efficient, large area CdS/$CuInSe_2$ heterojunction solar cells is described. Two methods of fabricating the $CuInSe_2$ were investigated; flash evaporation and dual source, $CuInSe_2$ and Se, coevaporation. Data on film structure using x-ray diffraction, film stoichiometry using x-ray fluorescence, and grain size measurements using transmission electron microscopy are presented for each method of fabrication. Preliminary 0.45% efficient CdS/$CuInSe_2$ devices are described.

52787 (SAND—78-7039(Vol.2)) **Regional conceptual design and analysis studies for residential photovoltaic systems. Final report, September 1977-September 1978.** Buerger, E.J.; Chan, T.S.; Fogaroli, R.P.; Kirpich, A.; Mehalick, E.M.; O Brien, G.; Shepard, N.; Tully, G.F.; Woodson, R.D. (General Electric Co., Philadelphia, PA (USA). Space Div.). Jan 1979. Contract EY-76-C-04-0789. 463p. P 20/MF A01.

Conceptual design and analyses of photovoltaic (PV) systems are presented for residences applicable to various regions of the United States during the mid-1980 time period. A wide range of roof-mounted array systems was studied including PV-only systems and combined and separate PV/thermal collection systems which provide heat for space conditioning and domestic hot water. The attractiveness of the system options were assessed in terms of performance and economic competitiveness based on hourly weather data for twelve designated regions of the US representing a broad spectrum of climatic characteristics. The study determined that if PV economic goals are achieved, PV-only solar energy systems for residential use should be emphasized because of their potential economic viability in all regions. On the basis of the costs and benefits used in the analysis, residential systems without batteries are preferred over systems with batteries assuming utility feedback acceptance at some differential buy-back rate such as 40 to 50% of the sell rate. Side-by-side PV/thermal systems become more viable across the nation with a PV system cost to thermal system cost ratio of 1. The combined PV/thermal collector systems were economically unattractive due to the projected performance and costs assumed in the study. Based on the study results, the immediate implementation of a residential test program is recommended. As part of the study, designs were developed for a habitable test house and a residential test-bed facility to the requirements of the test program. These facilities should be considered in the southwest, northeast, and southeast regions of the country in that order.

52788 (SAND—79-7040) **Novel concentrator photovoltaic converter system development. Final report.** Bedair, S.M.; Lamorte, M.F.; Hauser, J.R. (Sandia Labs., Albuquerque, NM (USA)). Jul 1979. Contract EY-76-C-04-0789. 206p. P 10/MF A01.

The long-range objective of this work is to develop, synthesize, and evaluate a novel cascade solar cell having an AM 1 conversion efficiency of 30 percent or greater and capable of operating at both high illumination levels and elevated temperatures. The first year's work has been oriented toward demonstrating the cascade solar cell concept whereby two cells are internally connected in a monolithic structure to provide a voltage aiding series arrangement of the cells. Accomplishments during the first year include studies of the lower bandgap cell, the upper bandgap cell, and the low impedance connecting junction. The material systems studied include GaInAs, AlGaAs, GaInP, and AlGaInAs. The major accomplishment of the work has been the first experimental demonstration of a cascade solar cell structure in the CaAs/AlGaAs materials system. Test cells have demonstrated open circuit voltages as high as 2.2 volts and efficiencies in the 10 to 15% range without antireflecting layers.

52789 (SERI/TP—34-048, pp 157-224) **Concentrators for photovoltaics.** Backus, C.E.; Wood, B.D. (Arizona State Univ., Tempe). Aug 1978.

From SERI concentrator symposium; Denver, CO, USA (13 Jun 1978).

A brief review is first given of concentrator photovoltaic development activities. A tutorial discussion on the basics of photovoltaics is then presented. Predictions of concentrator cell performance relative to resistivities, design, and temperature are discussed. The current state of technology is reviewed with emphasis on concentrator cell testing and performance results to date. Different approaches to technology development of photovoltaic concentrator systems, cost goals and estimates, and major problems are treated briefly. Finally, two appendices summarize conclusions and recommendations of the silicon technology group and the gallium arsenide group workshops. (LBS)

52790 (UCID—18245) **Cu/sub x/S-CdS cell formation utilizing reactive sputtering techniques. Technical progress report, July 1, 1978-March 31, 1979.** Armantrout, G.A.; Partain, L.D.; Yee, J.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Aug 1979. Contract W-7405-ENG-48. 44p. P 03/MF A01.

Extensive equipment modifications were performed to allow the direct fabrication of all-sputtered Cu/sub x/S-CdS cells. The best all-sputtered cell had an efficiency of ~ 0.5%. The principal problem is associated with low short circuit current caused by high interface and space charge region (SCR) losses. Indium doping for the sputtered CdS resistivity control was found to be unsatisfactory. The EBIC measurements were improved with a new deconvolution approach. The significant results of the EBIC analysis of a number of samples were: (1) L/sub e/(Cu/sub x/S) is relatively constant in the 0.1 to 0.25 μm range for the measured cells, (2) interface losses were the most important and varied by 3 to 4 orders of magnitude between different cells and by 2 orders of magnitude within the same

cell with heat treatment, and (3) SCR losses vary by over an order of magnitude between samples and following heat treatment. Junction I-V mechanisms were investigated experimentally and theoretically and were best explained by a space-charge-limited current region in series with an ideal diode. Theoretical calculations of maximum cell performance were performed using present knowledge and results. They showed that the efficiency of a planar junction structure would be limited to less than 8% unless L/sub s/(Cu/sub x/S) can be significantly increased or V/sub oc/ increased by some means such as the use of a mixed sulfide substrate. Present work involves determining the cause of the high interface loss on unetched cells, determining the maximum attainable value of L/sub e/(Cu/sub x/S), and assessing the overall utility of forming a Cu/sub x/S-CdS cell using reactive sputtering techniques.

52791 Solar energy collector. Rex, D. (to Erno Raumfahrttechnik GmbH). US Patent 4,153,474. 8 May 1979. Priority date 19 Dec 1975, German, Federal Republic of (F.R. Germany), 6p.

A solar panel is constructed from plural parabolic-cylindrical mirrors arranged side by side, and each mirror has three functions. Its concave ground focusses solar energy, its convex rear carries a strip-like solar cell being thereby disposed close to the focal line of the adjacent mirror, while the rest of the rear surface and possibly also the ground surface dissipates thermal energy.

52792 Aspherical solar cell concentrator. Nelson, R.B. (to Varian Associates, Inc.). US Patent 4,146,408. 27 Mar 1979. Filed date 23 Dec 1977. 6p.

A light concentrator for use with photovoltaic cells has a novel aspherical shape to provide the desired distribution of energy over the surface of the cell. The cell is usually circular with a current-collecting bus electrode around the circumference of the active surface. To provise for minimum resistive losses due to the current generated in the cell and flowing to the bus, the light may be concentrated in a band just inside the bus with reduced or even zero energy density inside the band. This distribution is obtained by making the ray-deflecting surface of the concentrator as a figure of revolution whose generating line focuses incident rays arriving parallel to the axis of revolution onto a point removed from the axis. Thus, a point source at infinity is focused into a circle around the axis instead of the point focus of conventional optics. Solar light is focused into an annular ring. Since the concentrated light pattern is larger than the true image formed by conventional optics with the same focal length, for a given size of cell the focal length can be made shorter and hence the accuracy tolerance of the concentrator surface is greatly relaxed, providing a reduction of cost.

52793 Measuring the quasi-Fermi level and flat band potential of an illuminated Au/n-$GaAs_{0.6}P_{0.4}$ anode. Pinson, W.E. (Infrared Photo Ltd., Ottawa, Ontario). pp 2.1.1.1-2.1.1.12 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

The positions of the quasi-Fermi levels in the illuminated semiconductor electrode, relative to the redox potentials of the electrolyte, play a key role in the operation of semiconductor liquid-junction solar cells. A simple method for determining the quasi-Fermi levels in the anode of such a <Au/n-$GaAs_{0.6}P_{0.4}$ parallel K_2SO_4 parallel Pt> cell is presented. Here Au represents a thin porous gold film evaporated onto the $GaAs_{0.6}P_{0.4}$ = $GaAsP^0$ surface which converts the anode into a Schottky barrier. The method consists in monitoring the anode potential, V/sub n/, and the gold film potential, V/sub Au/, relative to a SCE reference electrode as the external potential and cell load are varied. V/sub n/ = the electron quasi-Fermi level and V/sub Au/ = the minority hole quasi-Fermi level in the anode. The method is applied here to follow changes in the flat band potential and depletion layer polarization of the anode, as well as its quasi-Fermi levels. The results indicate that the gold/electrolyte, rather than the $GaAsP^0$/electrolyte, interface determines the photoelectrochemical properties of the anode. The open circuit results obtained here are useful, nevertheless, in determining the positions of the quasi-Fermi levels in a bare $GaAsP^0$ anode where the flat band potential of the anode is fixed by the $GaAsP^0$/electrolyte interaction.

52794 Photovoltaic properties of metal-free phthalocyanines: Al/H_2Pc Schottky barrier solar cells. Loutfy, R.O.; Sharp, J.H. (Xerox Research Centre of Canada Ltd., Mississauga, Ontario). pp 2.1.2.1-2.1.2.10 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

The photovoltaic properties of Schottky barrier solar cells, made by dispersing particles of the x-form of metal-free phthalocyanine in a binder polymer and sandwiched between NESA (SnO_2/Sb) and aluminum electrodes, have been studied. A power conversion efficiency of over 4% at low power densities (0.14 W/M^2) has been obtained for monochromatic irradiation at 670 nm. At peak solar power density (1400 W/M^2) the extrapolated power conversion efficiency for 670 nm irradiation decreases to 0.1%. The decrease in eta with intensity was attributed to a space charge limitation due to non-linear resistance. The devices exhibit V/sub oc/'s as high as 1.1 Volt, but are still limited by a field dependent quantum efficiency. Analysis of the action spectra of these devices revealed the formation of a thin photoactive depletion region (~ 800 A) at the semiconductor/metal interface. These devices are capable of capturing 50% of the solar spectrum within the photoactive region. The effect of pigment loading, cell thickness, light intensity, binder materials, doping and dye sensitization has been studied. Based upon sunlight absorption, theoretical efficiencies for these devices appear high.

52795 Modular assembly of a photovoltaire solar energy receiver. Graven, R.M.; Gorski, A.J.; Schertz, W.W.; Graae, J.E.A. (to Department of Energy). US Patent Application 829,122. 30 Aug 1977. 6p.

There is provided a modular assembly of a solar energy concentrator having a photovoltaic energy receiver with passive cooling. Solar cell means are fixedly coupled to a radiant energy concentrator. Tension means bias a large area heat sink against the cell thereby allowing the cell to expand or contract with respect to the heat sink due to differential heat expansion.

THERMIONIC AND THERMOELECTRIC CONVERSION

REFER ALSO TO CITATION(S) 52966

BIOMASS PRODUCTION AND CONVERSION

REFER ALSO TO CITATION(S) 52729, 52730, 52731, 52732, 52733, 52735, 53353, 53360, 53546, 53622

52796 (CONF-790638—4) Preliminary characterization of TASE biomass technologies. Harper, J.P.; Ballou, S.W.; Habegger, L.J.; Sobek, A.A.; Antonopoulos, A.A. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 11p. P 02/MF A01.

From 3. annual biomass energy systems conference; Golden, CO, USA (5 Jun 1979).

In 1978, the US Department of Energy initiated the TASE (Technology Assessment of Solar Energy) Program to assess the environmental consequences of increased utilization of solar energy. An overview of the TASE Program and a discussion of the biomass technologies characterized in Phase I is presented. Appropriate biomass conversion technologies were selected for various biomass feedstocks (i.e., agricultural and forestry residues, municipal wastes, manures, and agricultural and forestry energy crops). The technology characterization process involved: description of a model system; input/output analysis of material and energy flows into the system; estimation of the amount of residuals (e.g., particulates, SO/sub x/, etc.) generated during conversion; and estimation of capital and operating and maintenance costs for each system. Results were computed on a per Quad (10^{15} Btu) basis and coded for input into the SEAS (Strategic Environmental Assessment System) model. This discussion of the TASE biomass technology characterizations focuses on agricultural residues, forestry industry residues, and livestock wastes.

52797 (CONF-790638—5) Potential water quality impacts from large scale crop residue harvesting. Torpy, M.F.; Habegger, L.J.; Chiu, S.Y.; Barisas, S. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 5p. P 02/MF A01.

From 3. annual biomass energy systems conference; Golden, CO, USA (5 Jun 1979).

The design methodology and some of the results of a study on the location in the conterminous US and effects of substituting solar for coal energy is described. A scenario similar to a maximum solar penetration scenario is addressed and the relative increases in sheet erosion with and without biomass residue harvesting are evaluated. Changes in erosion is projected by using the Universal Soil Loss Equation. Some results are described in relation to the continuing studies which will address comparisons between coal and solar erosion and water quality impacts.

52798 (SAN—0034-1) Large-scale freshwater microalgal biomass production for fuel and fertilizer. Final report, October 1, 1977—September 30, 1978. Benemann, J.R.; Weissman, J.C.; Koopman, B.L.; Eisenberg, D.M.; Goebel, R.P.; Oswald, W.J. (California Univ., Richmond (USA). Sanitary Engineering Research Lab.). 18 Dec 1978. Contract EY-76-S-03-0034-279. 196p. P 09/MF A01.

Cultivation technology of microalgae for solar energy conversion was investigated. The key aspects studied were maintenance of a stable high-productivity culture and the development of low-cost harvesting technologies. An engineering-economic feasibility analysis indicates that the production of microalgal biomass for chemicals and fuels may be feasible at favorable locations if a simple bioflocculation-settling harvesting process can be developed. A

series of experiments was carried out with small-scale (12 sq m) ponds using sewage as the substrate. Detention time was found to be the key operational factor and its optimization was studied in a series of experiments which demonstrated that the algal colony size was affected by changes in detention time. A batch-settling process was investigated for harvesting and the conditions determined which induced rapid flocculation. Detention time and mixing were found to be important factors in promoting a bioflocculating culture. Algal separation was also carried out with a 32,000-liter fill and draw settling tank. Removal efficiencies exceeded 90% for both chlorophyll and suspended solids. Additional experiments carried out under this project were the anaerobic digestion of microalgae harvested from the pilot ponds. Nitrogen-fixing blue-green algae were cultivated on synthetic media with carbon dioxide-enriched air. The main algae used were Anabaenopsis. Temperature was a key factor in its growth and productivities were relatively low; even at 25°C, only about 6 to 8 g/sq m/day during the spring were observed. Regrowth of algae on the mixed digester effluents diluted with tap water was carried out in 12 sq m growth ponds with or without carbide addition. Production of fuels from sewage-grown algae was demonstrated to be of near-term practical potential. Significant progress has been made in decreasing costs of microalgal biomass through the harvesting process of bioflocculation-settling.

52799 (STUDSVIK/E2—79/36) **Material problems at combustion and gasification of biomass (peat and wood products).** Tarkpea, P. (Studsvik Energiteknik AB, Nykoeping (Sweden)). Apr 1979. 42p. (In Swedish). U 03/MF A01.

Material problems at combustion and gasification of biomass in fluidized bed have been studied. Relations between the composition of the fuel and the material problems are summarized and different high temperature corrosion phenomena are described.

52800 (TID—29402) **Production of sugarcane and tropical grasses as a renewable energy source. Second quarterly report, September 1-November 30, 1977.** Alexander, A.G. (Puerto Rico Univ., Rio Piedras). 1977. Contract EG-77-G-05-5422. 56p. P 04/MF A01.

Research dealing with the agronomic and economic feasibility of tropical grass production as a renewable energy source was continued during the period Sept. 1 through Nov. 30, 1977. Greenhouse screening for total biomass production, growth curves, chemical growth stimulation, and tissue composition was performed with clones from the genera Saccharum, Sorghum, and Erianthus. Field plot work was initiated with three Saccharum hybrids and the napier grass clone Merker (Pennisetum purpureum). Candidate clone selection and seed expansion was also begun at the field-plot level with local tropical forage grasses, Saccharum hybrids from the AES-UPR cane breeding program, and several tropical grasses growing wild on the Island. A very promising candidate clone for short-rotation cropping (over a time-course of 6 to 12 weeks) was identified. Preliminary field-plot data indicate a superiority of napier grass over sugarcane for short-term production of dry matter. The scope of work to be performed during the next three to six months is briefly outlined.

52801 (TID—29403) **Production of sugarcane and tropical grasses as a renewable energy source. First annual report, June 1, 1977-May 31, 1978.** Alexander, A.G.; Gonzalez-Molina, C.; Ortiz-Velez, J. (Puerto Rico Univ., Rio Piedras). 1978. Contract EG-77-G-05-5422. 104p. P 06/MF A01.

Tropical grasses from Saccharum and related genera are being evaluated as candidates for intensive production of solar-dried biomass. Categories of candidate grasses include short-, intermediate-, and long-rotation species for intensive co-production with conventional food commodities. Minimum-tillage candidates are also sought for extensive production on marginal lands. The hybrid forage grass Sordan 70-A (Northrup-King Company) is the outstanding short-rotation plant tested to date. It completes both the tissue-expansion and maturation phases within 10 weeks, yielding at least 4 tons of oven-dry biomass per acre. Napier grass (var. Common Merker) is a promising intermediate-rotation crop which possibly may be exceeded by several napier grass hybrids. Interspecific Saccharum hybrids and the Saccharum species S. spontaneum and S. sinense are being investigated for both long-rotation and minimum tillage cropping. Direct comparisons of sugarcane hybrids with napier grass indicate that sugarcane is an inferior candidate for short-term production of tropical forages. Sugarcane responded well to narrow spacing for about 6 months after seeding. Napier grass failed to respond to close spacing. Both species increased yields with decreasing frequency of harvest. Fertilization rates based on conventional sugar and forage production data were inadequate to sustain maximum biomass yields. Candidate grasses have shown two discrete biomass production phases, ie , tissue expansion which is highly visible but consists mainly of water, and tissue maturation which has little visibility but yields the bulk of the plants' dry matter. Additional progress was made in sugarcane growth control with chemical growth regulators.

52802 **Should Canada plan now to harness more of its renewable biomass energy.** pp 4.2.1.1-4.2.1.10 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

The successful current economic uses of direct and indirect uses of solar energy in a global context are summarized. The currently economically successful methods of storing direct and indirect solar energy are listed. The collection and storage of solar energy indirectly in the numerous forms of biomass are emphasized. (MHR)

52803 **Energy conservation: farm animal manure management via anaerobic digestion.** Ostrovski, C.M.; Sullivan, J.L. (Univ. of Western Ontario, London). pp 8.2.3.1-8.2.3.11 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

Manure is a good fertilizer and energy source if properly managed. Processing the manure anaerobically yields two products, methane gas and a plant nutritive sludge (fertludge). An energy audit was carried out to determine the effectiveness of this manure handling system in terms of energy input and energy output. The total energy audit considers the farm value of the manure, the digestion process, transportation of manure and fertludge, the gas and fertludge produced plus the energy required to produce an equal amount of manufactured fertilizer as found in the fertludge. It is shown that the anaerobic digestion process can salvage energy that is lost with present manure handling methods. The process assumes proper manure management, digester control and product utilization.

PHOTOVOLTAIC POWER PLANTS

52804 (DOE/ER—0032) **Utility interface requirements for a solar power system.** Donalek, P.J.; Whysong, J.L. (Harza Engineering Co., Chicago, IL (USA)). Sep 1978. Contract W-31-109-ENG-38. 76p. P 05/MF A01.

This study specifies that the southern tier of the US (south of the 36th parallel) should be examined to see what problems might develop with the installation of a Satellite Power System (SPS) in the year 2000. One or more 5-GW SPS units could be installed in the utility systems of the southern states in the year 2000. The 345- and 500-kV transmission systems that will probably exist at that time could be readily extended to accommodate the SPS units. The operation of the units will present the utilities with new and difficult problems in system stability and frequency control. The problems will arise because a somewhat variable 5-GW output will be produced by a generator having no mechanical inertia. The unavoidable time lag in controlling the position of the energy beam at the receiving station may have a very critical effect on the stability of the utility systems. The maintenance problems associated with the energy-receiving device, a continuous structure covering more than 40 mi^2, must be given careful consideration. Repair of lightning damage while maintaining SPS operation may be the most critical requirement. Acquisition and preparation of the 90 mi^2 land required for the receiving antenna (rectenna) will create many new and difficult environmental problems.

52805 (HCP/T5433—01) **Criteria for an ideal solar photovoltaic powered industry.** (Wizard Research and Development Group, Inc., Washington, DC (USA)). Jun 1979. Contract ET-78-X-01-5433. 74p. P 04/MF A01.

A study based on the results of a literature survey on the application of solar photovoltaic energy and the use of energy in the Primary Metals Industries is given. A criteria is outlined for an ideal solar photovoltaic powered industry and the Primary Metals Industries is evaluated with respect to this criteria. Some of the major findings of this report are: (1) The most important requirements of an ideal solar photovoltaic powered industry are the ability to use dc electrical power, ability to be located in Southern California or the Southwestern US and ability to do without power for extended periods of time. (2) The costs of varying from the ideal are most severe with respect to the loss of power element of the criteria. (3) Although most of the industries in the Primary Metals group use tremendous amounts of electrical energy, the general requirements of an uninterruptable power source makes them less than ideal users of photovoltaic energy. (4) It appears to be both technologically and economically feasible to develop processes which would make at least four of the seven members of the Primary Metals Industries ideal solar photovoltaic powered industries.

SOLAR THERMAL POWER PLANTS

REFER ALSO TO CITATION(S) 52759, 52804, 52968, 52972, 52976, 52977, 52994, 52998, 53042, 53043

52806 (COO—4878-6) **Advanced solar receiver development.** Jarvinen, P.O. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 1979. Contract ET-78-S-02-4878. 5p. (CONF-790541—49). P 02/MF A01.

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Ceramic receivers for advanced solar Brayton and advanced solar Stirling thermal power systems are considered which utilize impingement jet cooled silicon carbide ceramic dome heat exchanger modules in conjunction with a cavity receiver geometry to heat a pressurized gaseous heat transfer fluid to temperatures in the range from 1800 to 2400°F. Conceptual designs of single and multiple-dome ceramic cavity receivers are presented and analyzed and a combined analytical and experimental program to develop a high temperature seal for the ceramic dome module is reported.

52807 (COO—4878-7) **Conceputual design of a solar-heated-air receiver coupled to a Brayton or Stirling engine.** Hamilton, N.I.; Jarvinen, P.O. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 1979. Contract ET-78-S-02-4878. 5p. (CONF-790541—51). P 02/MF A01.

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A particularly interesting possibility for a parabolic dish/cavity receiver combination is the coupling of the cavity to a Stirling or Brayton engine. The design of the receiver is a pacing item in the development of the approach and requires knowledge of the flux distribution within the receiver. Thus several cavity configurations need to be considered to ascertain the trade-offs between cavity geometry and flux distribution. Simple analytical tools developed are applied to the analysis and design of a dome-capped cylindrical receiver that has desirable characteristics for transferring heat to a Dish/Brayton or Dish/Stirling system.

52808 (N—79-14143) **Accuracy analysis of pointing control system of solar power station. Final report, 23 June - 23 December 1978.** Hung, J.C.; Peebles, P.Z. Jr. (Tennessee Univ., Knoxville (USA). Dept. of Electrical Engineering). 23 Dec 1978. Contract NAS8-33065. 73p. Y A04/MF A01.

The first-phase effort concentrated on defining the minimum basic functions that the retrodirective array must perform, identifying circuits that are capable of satisfying the basic functions, and looking at some of the error sources in the system and how they affect accuracy. The initial effort also examined three methods for generating torques for mechanical antenna control, performed a rough analysis of the flexible body characteristics of the solar collector, and defined a control system configuration for mechanical pointing control of the array.

52809 (SAN—1101/PA2-16) **Solar powered irrigation systems. Technical progress report.** (Aerospace Corp., El Segundo, CA (USA). Energy and Transportation Div.). 15 Jul 1977. Contract EY-76-C-03-1102-002. 91p. (ATR—77(7523-24)-1). P 05/MF A01.

The study objective is to determine the technical and economic feasibility and the potential market within the agricultural community for solar power systems designed for pumping water and perhaps for meeting other farm power needs. The fundamental techniques and economics of irrigated agriculture are studied, and the importance of irrigation on a national basis is discussed. Also discussed are the selection of representative states for subsequent analysis and the development of analytical techniques and models which will be used in the study.

52810 (SAND—78-8511) **Department of Energy Large Solar Central Power Systems semiannual review.** (Sandia Labs., Albuquerque, NM (USA)). Nov 1978. Contract EY-76-C-04-0789. 304p. P 14/MF A01.

The 32 papers presened were entered in the data base separately. (WHK)

52811 (SAND—78-8511, pp 11-13) **Organization and financial plan for solar thermal large power systems.** Kaplan, G. (Dept. of Energy, Washington, DC). Nov 1978.

In Department of Energy Large Solar Central Power Systems semiannual review.

52812 (SAND—78-8511, pp 14-21) **Solar Thermal Large Power Systems Program.** Skinrood, A.C. (Sandia Lab., Livermore, CA). Nov 1978.

In Department of Energy Large Solar Central Power Systems semiannual review.

52813 (SAND—78-8511, pp 22-28) **Solar Energy Research Institute (SERI) plans and objectives.** Woodley, N.H. (Solar Energy Research Inst., Golden, CO). Nov 1978.

In Department of Energy Large Solar Central Power Systems semiannual review.

52814 (SAND—78-8511, pp 147-153) **Exploratory R & D in areas of solar thermal technology.** Vant-Hull, L.L. Nov 1978.

In Department of Energy Large Solar Central Power Systems semiannual review.

52815 (SAND—78-8511, pp 177-182) **ASME solar energy standards power subcommittee status.** Moore, C.W. (Sandia Labs., Livermore, CA). Nov 1978.

In Department of Energy Large Solar Central Power Systems semiannual review.

52816 (SAND—78-8511, pp 191-196) **Hydraulic stability of solar boilers.** Isbin, H.S. Nov 1978.

In Department of Energy Large Solar Central Power Systems semiannual review.

52817 (SAND—79-8508) **Department of Energy Large Solar Central Power Systems semiannual review.** (Sandia Labs., Albuquerque, NM (USA)). May 1979. Contract EY-76-C-04-0789. 263p. P 12/MF A01.

The 30 papers presented are included separately in the data base. (WHK)

52818 (SAND—79-8508, pp 9-12) **Overview of the Large Solar Central Power Systems Program.** Braun, G. (Dept. of Energy, Washington, DC). May 1979.

In Department of Energy Large Solar Central Power Systems semiannual review.

52819 (SAND—79-8508, pp 13-22) **Technical overview: Large Solar Central Power Systems Program.** Skinrood, A.C. (Sandia Labs., Livermore, CA). May 1979.

In Department of Energy Large Solar Central Power Systems semiannual review.

52820 (SAND—79-8508, pp 227-229) **SERI/DOE Quality Assurance and Standards Program.** DeBlasio, D. May 1979.

In Department of Energy Large Solar Central Power Systems semiannual review.

52821 (SAND—79-8508, pp 245-251) **Experimental investigation of convective losses from solar receivers.** Clausing, A.M.; Clark, G.L. Jr.; Mueller, M.H.; Weiner, J.G. (Univ. of Illinois, Urbana). May 1979.

In Department of Energy Large Solar Central Power Systems semiannual review.

52822 (SAND—79-8508, pp 253-264) **Analysis of mesoscale weather and climate changes caused by large solar electric power plants and their effect on plant performance.** Bhumralkar, C.M.; Slemmons, A.J. (SRI International, Menlo Park, CA). May 1979.

In Department of Energy Large Solar Central Power Systems semiannual review.

52823 (SAND—79-8508, pp 265-271) **Materials testing for central receiver solar-thermal power systems.** Majumdar, S. (Argonne National Lab., IL). May 1979.

In Department of Energy Large Solar Central Power Systems semiannual review.

52824 (SERI/TP—31-061, pp 93-109) **Dispersed power systems: projects and requirements.** Leonard, J.A. (Sandia Laboratories, Albuquerque, NM). Aug 1978.

From Thermal power systems workshop on selective absorber coatings; Golden, CO, USA (6 Dec 1977).

DOE's Dispersed Solar Power Systems program is outlined, and absorptive coating requirements of this program are briefly discussed. Some of the conditions and environments such coatings must survive are described. (WHK)

52825 (SERI/TP—31-061, pp 381-407) **Effects of surface optical characteristics on point focusing solar collectors.** Wen, L.; Caputo, R. (Jet Propulsion Lab., Pasadena, CA). Aug 1978.

From Thermal power systems workshop on selective absorber coatings; Golden, CO, USA (6 Dec 1977).

The sensitivity of surface optical characteristics on the performance of representative point focusing solar collectors is assessed from a system point of view. Variations of mirror specular reflectance and selective coating applications inside cavity receivers are the main subject of investigation. The trade-off relationship is presented in terms of rated system efficiency as a function of operating conditions and pertinent design parameters.

52826 (SERI/TP—34-048, pp 303-310) **Materials - fluid compatibility.** Pohlman, S. (Solar Energy Research Inst., Golden, CO). Aug 1978.

From SERI concentrator symposium; Denver, CO, USA (13 Jun 1978).

Major materials - fluid compatibility problems that exist in thermal power solar energy systems were identified. The problem areas that should be investigated to insure reliability of the various systems were outlined. Several areas, including thermal conversion, reflector desirability, thermal storage systems, and structural degradation, were discussed.

CENTRAL RECEIVER

REFER ALSO TO CITATION(S) 53014, 53040, 53041

52827 (SAND—78-8511, pp 29-37) **10 MW/sub e/ Solar Thermal Central Receiver Pilot Plant.** Schweinberg, R.N. (Dept. of Energy, Washington, DC); Rasband, J.L. Nov 1978.

In Department of Energy Large Solar Central Power Systems semiannual review.

52828 (SAND—78-8511, pp 38-52) **Operation of the Solar Thermal Test Facility.** Marshall, B.W. (Sandia Labs., Albuquerque, NM). Nov 1978.

In Department of Energy Large Solar Central Power Systems semiannual review.

The Solar Thermal Test Facility (STTF) at Albuquerque, New Mexico, has been constructed to test components and subsystems for the Department of Energy (DOE) Large Solar Central Power Systems Program. Facility construction activities, exclusive of an office/laboratory addition to the control building and an assembly/warehouse building, are presently being completed. The first phase of the formal facility acceptance tests was completed by a DOE/Sandia team in July, and the final phase is scheduled for early October. During June and July, extensive solar operations to characterize the heliostat field were conducted using the 1-MW/sub t/ Working Receiver (WR) as the target. In addition, the Real Time Aperture Flux (RTAF) system, a diagnostic tool to be used in the tower to measure the flux pattern incident on receivers during a test, was tested and the data correlated with those from the WR. Other ongoing activities include reflectivity characterization and maintenance of the STTF heliostats; development of a system for evaluating prototype heliostats; installation of the first two receivers to be tested at the facility; and design of a flux reconcentrator to be used for very high flux density (> 10 MW/m^2) materials tests.

52829 (SAND—78-8511, pp 53-60) **International Energy Agency Solar Power Stations Project.** Selvage, C.S. (Sandia Labs., Livermore, CA). Nov 1978.

In Department of Energy Large Solar Central Power Systems semiannual review.

52830 (SAND—78-8511, pp 61-64) **Systems analysis.** Eicker, P.J. (Sandia Labs., Livermore, CA). Nov 1978.

In Department of Energy Large Solar Central Power Systems semiannual review.

52831 (SAND—78-8511, pp 75-84) **Conceptual design of advanced central receiver power systems. Sodium-cooled receiver concept Phase I.** Springer, T. Nov 1978.

In Department of Energy Large Solar Central Power Systems semiannual review.

52832 (SAND—78-8511, pp 85-95) **Closed cycle Brayton Advanced Central Receiver Solar Thermal Electric Power Plant.** Gintz, J. (Boeing Engineering & Construction, Seattle, WA). Nov 1978.

In Department of Energy Large Solar Central Power Systems semiannual review.

52833 (SAND—78-8511, pp 96-105) **Conceptual design of advanced central receiver power systems.** Salemme, R.M. Nov 1978.

In Department of Energy Large Solar Central Power Systems semiannual review.

52834 (SAND—78-8511, pp 106-114) **Conceptual design of an advanced central receiver power system utilizing molten salt: Phase I.** Tracey, T.R. Nov 1978.

In Department of Energy Large Solar Central Power Systems semiannual review.

52835 (SAND—78-8511, pp 115-124) **Solar central receiver prototype heliostat development.** Gillette, R. Nov 1978.

In Department of Energy Large Solar Central Power Systems semiannual review.

52836 (SAND—78-8511, pp 125-135) **Solar central receiver prototype heliostat.** Easton, C.R. Nov 1978.

In Department of Energy Large Solar Central Power Systems semiannual review.

52837 (SAND—78-8511, pp 136-143) **Prototype heliostat development.** Mitchell, W.D. Nov 1978.

In Department of Energy Large Solar Central Power Systems semiannual review.

A preliminary design with appropriate trade-offs, together with the accompanying manufacturing plan and production cost estimates, has been completed. The innovative developments include: (1) a tilted azimuth axis control which precludes control singularities and reduces the azimuth drive excursion and rate requirement; (2) control by a single linear actuator for each axis; (3) mirror modules fabricated from foam glass and silvered microglass reflector; (4) integrated pedestal-foundation using a hollow, spun cast, prestressed concrete pedestal installed with pole set; and (5) heliostat control by individual microprocessor.

52838 (SAND—78-8511, pp 144-146) **Heliostat development.** Buggy, J. Nov 1978.

In Department of Energy Large Solar Central Power Systems semiannual review.

52839 (SAND—78-8511, pp 154-160) **Materials testing for central receiver solar-thermal power systems.** Majumdar, S. (Argonne National Lab., IL). Nov 1978.

In Department of Energy Large Solar Central Power Systems semiannual review.

52840 (SAND—78-8511, pp 161-176) **Interim structural design standard for solar energy applications.** Berman, I.; Gangadharan, A.C.; Gupta, G.D.; Narayanan, T.V. Nov 1978.

In Department of Energy Large Solar Central Power Systems semiannual review.

52841 (SAND—78-8511, pp 183-186) **Receiver tower conceptual design.** Lang, W. (Stearns-Roger, Denver, CO). Nov 1978.

In Department of Energy Large Solar Central Power Systems semiannual review.

52842 (SAND—78-8511, pp 187-190) **Experimental investigation of convective losses from solar receivers.** Clausing, A.M.; Clark, G.L. Jr.; Mueller, M.H.; Weiner, J.G. Nov 1978.

In Department of Energy Large Solar Central Power Systems semiannual review.

52843 (SAND—78-8511, pp 197-205) **Pilot plant receiver testing at STTF.** Coleman, G. Nov 1978.

In Department of Energy Large Solar Central Power Systems semiannual review.

52844 (SAND—78-8511, pp 206-214) **Heliostat technology studies.** Wilson, W.G. (Sandia Labs., Livermore, CA). Nov 1978.

In Department of Energy Large Solar Central Power Systems semiannual review.

52845 (SAND—78-8511, pp 215-239) **Heliostat glass survey and evaluation.** Lind, M.A.; Rusin, J.M. (Battelle, Pacific Northwest Labs., Richland, WA). Nov 1978.

In Department of Energy Large Solar Central Power Systems semiannual review.

The glass characterization and specification task included a comprehensive survey of both foreign and domestic sources of low distortion, low iron, 0.125 in. normal flat glass for heliostat applications. PNL attempted to determine the availability of production lines, estimate industry interest, lead times, and costs for producing glass for second surface heliostat mirrows for the Barstow pilot plant and future commercial plants. Eleven different flat glass samples from seven domestic and one foreign source have been evaluated for solar transmittance, flatness, and durability. The results of the survey and analysis were used to generate a specification for the Barstow pilot plant glass procurement. Three different glass forming processes are represented by the data: float, fusion, and rolled. In the float process, the molten glass is layed onto a bed of molten tin and mechanically stretched to its desired thickness. In the fusion process, the molten glass is allowed to overflow a trough-like container and is drawn down by gravity and mechanically pulled to its desired thickness. In the rolled process, the molten glass flows between a series of rollers and is extruded to its desired thickness. Each process has its own advantages and disadvantages for producing glass for heliostat applications.

52846 (SAND—78-8511, pp 240-244) **Heliostat manufacturing technology.** Drumheller, K. (Battelle, Pacific Northwest Labs., Richland, WA). Nov 1978.

In Department of Energy Large Solar Central Power Systems semiannual review.

52847 (SAND—78-8511, pp 245-253) **DELSOL: a code for central receiver field performance and optimization.** Dellin, T.A. (Sandia Labs., Livermore, CA). Nov 1978.

In Department of Energy Large Solar Central Power Systems semiannual review.

DELSOL is an evolving computer code for quantifying the performance and optimizing the cost/performance of central receiver systems. It is an easy to use, relatively fast, and accurate engineering design tool based on a theoretical method for calculating the efficiency of heliostat fields. Special featurs of the code include a detailed description of heliostat error sources and the deviation of the analytical dependence of the system performance on variables such as tower height, receiver size, and receiver type. This latter capability means that the codes running time is significantly sublinear with respect to the number of cases analyzed and this makes tractable the large number of annual performance calculations required in design tradeoff and optimization studies. The code is described and representative results are given.

52848 (SAND—79-8508, pp 23-39) **10 MW/sub e/ Solar Thermal Central Receiver Pilot Plant.** Schweinberg, R.N. (Dept. of Energy, Washington, DC); Reeves, J.N. May 1979.
In Department of Energy Large Solar Central Power Systems semiannual review.

52849 (SAND—79-8508, pp 41-45) **500 kW/sub e/ Central Receiver System (CRS) of the IEA Small Solar Power Systems Project (SSPS).** Grasse, W. (International Energy Agency, Paris, FR). May 1979.
In Department of Energy Large Solar Central Power Systems semiannual review.

52850 (SAND—79-8508, pp 47-64) **Operation of the Central Receiver Test Facility.** Marshall, B.W. (Sandia Labs., Albuquerque, NM). May 1979.
In Department of Energy Large Solar Central Power Systems semiannual review.

52851 (SAND—79-8508, pp 79-88) **Trade-offs in central receiver systems.** Dellin, T.A. (Sandia Labs., Livermore, CA). May 1979.
In Department of Energy Large Solar Central Power Systems semiannual review.

52852 (SAND—79-8508, pp 115-123) **Conceptual design of advanced central receiver power systems.** Elsner, J.A.; Pomeroy, B.D. May 1979.
In Department of Energy Large Solar Central Power Systems semiannual review.

52853 (SAND—79-8508, pp 125-134) **High-temperature line-focus solar thermal central power system.** Slemmons, A. (SRI International, Menlo Park, CA). May 1979.
In Department of Energy Large Solar Central Power Systems semiannual review.

52854 (SAND—79-8508, pp 161-169) **Heliostat Development Program.** Wilson, W.G. (Sandia Labs., Livermore, CA). May 1979.
In Department of Energy Large Solar Central Power Systems semiannual review.

52855 (SAND—79-8508, pp 171-177) **Heliostat drive system development.** Mitchell, W. May 1979.
In Department of Energy Large Solar Central Power Systems semiannual review.

52856 (SAND—79-8508, pp 179-184) **One-piece plastic dome fabrication.** Gillette, R. (Boeing Engineering and Construction Co., Seattle, WA). May 1979.
In Department of Energy Large Solar Central Power Systems semiannual review.

52857 (SAND—79-8508, pp 185-187) **Second-generation heliostat development.** Steinmeyer, D.A. May 1979.
In Department of Energy Large Solar Central Power Systems semiannual review.

52858 (SAND—79-8508, pp 189-192) **Demonstration heliostat development.** Devlin, R.W. May 1979.
In Department of Energy Large Solar Central Power Systems semiannual review.

52859 (SAND—79-8508, pp 217-226) **Wind tunnel test of a full-scale heliostat in the NASA, Ames, 40- by 80-foot facility.** Peglow, S.G. (Sandia Labs., Livermore, CA). May 1979.
In Department of Energy Large Solar Central Power Systems semiannual review.

52860 (SAND—79-8508, pp 231-244) **Tower cost studies for central receiver studies.** Lang, W.R.; Colasanti, R.J. May 1979.
In Department of Energy Large Solar Central Power Systems semiannual review.

52861 (SAND—79-8508, pp 273-281) **Interim structural design standard for solar energy applications.** Gangadharen, A.C. May 1979.
In Department of Energy Large Solar Central Power Systems semiannual review.

52862 (SAND—79-8508, pp 195-202) **Heliostat mirror deterioration.** Burolla, V.P. (Sandia Labs., Livermore, CA). May 1979.
In Department of Energy Large Solar Central Power Systems semiannual review.

52863 (SAND—79-8508, pp 203-210) **Development of a portable reflectometer.** Weagant, R.A. May 1979.
In Department of Energy Large Solar Central Power Systems semiannual review.

52864 (SAND—79-8508, pp 211-215) **Non-inverting heliostat study: effects of dust buildup.** Blackmon, J.B. May 1979.
In Department of Energy Large Solar Central Power Systems semiannual review.

52865 (SERI/TP—31-061, pp 51-73) **Solar central receiver program.** Skinrood, A.C. (Sandia Labs., Livermore, CA). Aug 1978.
From Thermal power systems workshop on selective absorber coatings; Golden, CO, USA (6 Dec 1977).
The status of the 10 MW/sub e/ solar central receiver pilot plant to be constructed at Barstow, California, is outlined; and the DOE central receiver R & D program is outlined. Also, the usefulness of selective coatings to the central receiver program is briefly discussed. (WHK)

52866 (SERI/TP—31-061, pp 75-91) **Absorptive coatings evaluation for solar tower receiver application.** Tobin, R.D. (Rockwell International, Canoga Park, CA). Aug 1978.
From Thermal power systems workshop on selective absorber coatings; Golden, CO, USA (6 Dec 1977).
Efforts to select and evaluate a suitable high solar absorptance coating for solar tower receiver application were initiated in 1974 in a company funded project. The evaluation was continued in varying degrees in two separate ERDA contracts relating to the solar tower receiver concept. Emphasis in the latter efforts was directed toward evaluation of the prime candidate coatings under simulated solar tower operating conditions utilizing electrical, solar furnace and radiant heating test facilities. Two groups of nine different candidate surface treated (Incoloy 800 substrate) specimens were evaluated. One group in the as-received condition and the other after 90 hours in an ASTM weatherometer. These surface treatments included: (1) as machined (for reference purposes), (2) mechanical (grit blasted), (3) chemical (oxidized), (4) plasma spray, and (5) high temperature paints. Spectral reflectance (0.23 to 24 microns) and total emittance (at 1200^{0}F) measurements were made of all specimens. Results of these tests are presented and discussed. (WKH)

52867 **Solar power plants.** Bilgen, E.; Bourquin, J.P. (Lemieux, Monti, Nadon, Roy, Inc. Consultants, Montreal, Quebec). pp 2.4.2.1-2.4.2.16 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).
From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).
Since the energy crisis of 1973 the recognition of serious limitations in conventional energy sources has turned new attention to the utilization of solar energy. After a short review of the history of solar energy this paper deals with solar energy conversion and the various applications of thermo-electric solar energy. The main problem, thermal storage, is discussed with particular emphasis on its relationship to utility companies. The lack of Canadian funding by the Government for research and development is emphasized, in comparison with the important Government participation evident in other industrialized nations. The developing nations (where the sun shines almost continuously) have a large potential for the application of solar technology and hardware, and Canadian enterprise should take the necessary steps to ensure its participation in the design and installation of such applications.

DISTRIBUTED COLLECTOR

REFER ALSO TO CITATION(S) 52829, 52984

52868 (SAND—79-8508, pp 135-149) **Conceptual design of a line-focus solar central power system.** Schuster, J.R.; Neill, J.M. (General Atomic Co., San Diego, CA). May 1979.
In Department of Energy Large Solar Central Power Systems semiannual review.

52869 (SAND—79-8508, pp 151-160) **Conceptual design and analysis of a 100-MW/sub e/ line focus solar central power plant (LFPP).** Semmens, M.G. May 1979.
In Department of Energy Large Solar Central Power Systems semiannual review.

TOTAL ENERGY AND HYBRID SYSTEMS

52870 (ALO—3787-1(Exec.Summ.)) **Application analysis of solar total energy systems to the residential sector. Volume I, executive summary. Final report.** (Institute of Gas Technology, Chicago,

IL (USA)). Jul 1979. Contract EG-77-C-04-3787. 43p. P 03/MF A01.

The objectives of the program were to define solar total energy systems (STES) that are suitable for the residential sector and to assess the market penetration potential of these systems. Residential market segments were determined from data on housing inventory and building parameters selected for representative units of single-family detached homes, townhouses, low-rise apartments, and high-rise apartments. After dividing the country into regions based on climate, insolation, energy costs, and population, electrical and thermal energy requirements were determined for each building type in each region. In keeping with the 50 kWe (or greater) constraint, single-family detached homes were considered only as groups of houses connected to a central STE system of 100-kW electric generating capacity. After consideration of various collector types, candidate collectors deemed most appropriate to residential application of solar total energy systems were evaluated for performance in different regions and compatibility with appropriate energy conversion devices. Conceptual designs were then generated for suitable combinations of collectors and energy conversion devices, and their hourly performance evaluated by computer simulation over a one-year period. Results were used to determine system economics and to assess their potential for market penetration in the residential sector, based on projected costs and availability of competing energy sources in the 1985 to 2020 time frame. Although none of the systems were judged to have positive market penetration potential in the time frame of the study, sensitivity studies indicated those circumstances that would be required for market penetration feasibility.

52871 (ALO—3787-2) **Application analysis of solar total energy systems to the residential sector. Volume II, energy requirements. Final report.** (Institute of Gas Technology, Chicago, IL (USA)). Jul 1979. Contract EG-77-C-04-3787. 225p. P 10/MF A01.

This project analyzed the application of solar total energy systems to appropriate segments of the residential sector and determined their market penetration potential. This volume covers the work done on energy requirements definition and includes the following: (1) identification of the single-family and multi-family market segments; (2) regionalization of the United States; (3) electrical and thermal load requirements, including time-dependent profiles; (4) effect of conservation measures on energy requirements; and (5) verification of simulated load data with real data.

52872 (ALO—3787-3) **Application analysis of solar total energy systems to the residential sector. Volume III, conceptual design. Final report.** (Institute of Gas Technology, Chicago, IL (USA)). Jul 1979. Contract EG-77-C-04-3787. 335p. P 15/MF A01.

The objective of the work described in this volume was to conceptualize suitable designs for solar total energy systems for the following residential market segments: single-family detached homes, single-family attached units (townhouses), low-rise apartments, and high-rise apartments. Conceptual designs for the total energy systems are based on parabolic trough collectors in conjunction with a 100 kWe organic Rankine cycle heat engine or a flat-plate, water-cooled photovoltaic array. The ORC-based systems are designed to operate as either independent (stand alone) systems that burn fossil fuel for backup electricity or as systems that purchase electricity from a utility grid for electrical backup. The ORC designs are classified as (1) a high temperature system designed to operate at 600°F and (2) a low temperature system designed to operate at 300°F. The 600°F ORC system that purchases grid electricity as backup utilizes the thermal tracking principle and the 300°F ORC system tracks the combined thermal and electrical loads. Reject heat from the condenser supplies thermal energy for heating and cooling. All of the ORC systems utilize fossil fuel boilers to supply backup thermal energy to both the primary (electrical generating) cycle and the secondary (thermal) cycle. Space heating is supplied by a central hot water (hydronic) system and a central absorption chiller supplies the space cooling loads. A central hot water system supplies domestic hot water. The photovoltaic system uses a central electrical vapor compression air conditioning system for space cooling, with space heating and domestic hot water provided by reject heat from the water-cooled array. All of the systems incorporate low temperature thermal storage (based on water as the storage medium) and lead—acid battery storage for electricity; in addition, the 600°F ORC system uses a therminol-rock high temperature storage for the primary cycle. (WHK)

52873 (ALO—3787-4) **Application analysis of solar total energy systems to the residential sector. Volume IV, market penetration. Final report.** (Institute of Gas Technology, Chicago, IL (USA)). Jul 1979. Contract EG-77-C-04-3787. 326p. P 15/MF A01.

This volume first describes the residential consumption of energy in each of the 11 STES regions by fuel type and end-use category. The current and projected costs and availability of fossil fuels and electricity for the STES regions are reported. Projections are made concerning residential building construction and the potential market for residential STES. The effects of STES ownership options, institutional constraints, and possible government actions on market penetration potential were considered. Capital costs for two types of STES were determined, those based on organic Rankine cycle (ORC) heat engines and those based on flat plate, water-cooled photovoltaic arrays. Both types of systems utilized parabolic trough collectors. The capital cost differential between conventional and STE systems was calculated on an incremental cost per dwelling unit for comparison with projected fuel savings in the market penetration analysis. The market penetration analysis was planned in two phases, a preliminary analysis of each of the geographical regions for each of the STE systems considered; and a final, more precise analysis of those regions and systems showing promise of significant market penetration. However, the preliminary analysis revealed no geographical regions in which any of the STES considered promised to be competitive with conventional energy systems using utility services at the prices projected for future energy supplies in the residential market. Because no promising situations were found, the analysis was directed toward an examination of the parameters involved in an effort to identify those factors which make a residential STES less attractive than similar systems in the commercial and industrial areas. Results are reported. (WHK)

52874 (CONF-790541—41) **Solar-fossil hybrid power system using a combined cycle.** Lam, E.Y. (Bechtel National, Inc., San Francisco, CA (USA)). 1979. Contract ET-78-C-03-2051. 6p. P 02/MF A01.

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A solar central receiver hybrid power system concept which uses a gas turbine/heat recovery steam generator/steam turbine combined cycle to generate electricity from both solar and fossil fuel energy is described. The concept description dwells primarily on a near term 100 MWe (net) system that utilizes a state-of-the-art combined cycle with a gas turbine inlet temperature of 1093°C (2000°F). This system is implementable in the 1985 time frame. An advanced system that uses an inlet temperature of 1316°C (2400°F) is also described. Performance comparisons of these two systems are given. Major advantages of the system concept as well as its technical issues are highlighted.

52875 (SAND—78-8511, pp 65-74) **Technical and economic assessment of solar hybrid repowering.** Maddox, J.D. (Public Service Co., of New Mexico, Albuquerque). Nov 1978.

In Department of Energy Large Solar Central Power Systems semiannual review.

52876 (SAND—79-8508, pp 65-67) **DOE repowering program.** Elliott, S.D. Jr. May 1979.

In Department of Energy Large Solar Central Power Systems semiannual review.

52877 (SAND—79-8508, pp 69-77) **Solar repowering of utility electric plants.** Mathur, P.N. May 1979.

In Department of Energy Large Solar Central Power Systems semiannual review.

52878 (SAND—79-8508, pp 89-96) **Solar central receiver hybrid power system conceptual design: Molten Salt Receiver.** Bolton, C.N. May 1979.

In Department of Energy Large Solar Central Power Systems semiannual review.

52879 (SAND—79-8508, pp 97-105) **Solar Central Receiver Hybrid Power System sodium-cooled concept.** Springer, T. May 1979.

In Department of Energy Large Solar Central Power Systems semiannual review.

52880 (SAND—79-8508, pp 107-114) **Combined cycle solar central receiver hybrid power system.** Westsik, J.H. May 1979.

In Department of Energy Large Solar Central Power Systems semiannual review.

OCEAN THERMAL GRADIENT POWER PLANTS

52881 (APL/JHU-SR—79-1) **Lightweight concrete development program, Phase I. Special reports.** O'Connor, J.S. (ed.). (Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.). Apr 1979. Contract EG-77-A-29-1076. 319p. P 14/MF A01.

Two lightweight structural concrete mixes having average inplace unit weights in the range of 86 to 91 pcf (lb/ft^3) and compressive design strengths, f/sub c/', greater than 4000 psi have been produced for use in the cold-water pipe (CWP) of an Ocean Thermal Energy Conversion (OTEC) pilot plantship. Reinforced concrete is a desirable material for constructing a CWP because of its low cost, durability, low corrosion and compatibility problems, and its long history of marine use. The use of lightweight concrete reduces the dynamic loads on the pipe and the cost of pipe handling and deployment. The steps that were taken in selecting specific

concrete mixes are described and the properties of the approved mixes are given. Designs and cost estimates are given for constructing a CWP using lightweight concrete and a test program is presented for generating additional data.

52882 (CONF-790631—10) **Performance tests of the 1MWt shell-and-tube heat exchangers for OTEC.** Thomas, A.; Lorenz, J.J.; Hillis, D.L.; Yung, D.T.; Sather, N.P. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 11p. P 02/MF A01.

From 6. OTEC conference; Washington, DC, USA (19 Jun 1979).

Portions of document are illegible.

Final test results are reported for the five 1 MWt shell-and-tube heat exchangers tested at Argonne National Laboratory. These five heat exchangers are the Union Carbide flooded-bundle evaporator, the Union Carbide sprayed-bundle evaporator, the Union Carbide enhanced-tube condenser, the Carnegie-Mellon vertical fluted-tube evaporator, and the Carnegie-Mellon vertical fluted-tube condenser. Performance parameters measured include the overall heat transfer coefficient (U_0), the water-side pressure drop, and the vapor quality. Also measured were operational characteristics of the heat exchangers such as repeatability of results and the dependence of U_0 on heat duty, ammonia flow rate, and subcooling. Individual water-side and ammonia-side coefficients were deduced using the Wilson Plot method.

52883 (CONF-790631—11) **OTEC physical and climatic environmental impacts.** Ditmars, J.D.; Paddock, R.A. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 10p. P 02/MF A01.

From 6. OTEC conference; Washington, DC, USA (19 Jun 1979).

Assessment of Ocean Thermal Energy Conversion (OTEC) environmental impacts and resource utilization requires an understanding of the physical processes underlying the interactions between an OTEC plant or plants and the ocean. An overview of the US Department of Energy program for the development and application of analyses and models for the prediction of the physical aspects of OTEC impacts is presented. Predictive tools are necessary to address problems at different site areas, scales of OTEC deployment, and time horizons. The effects of intake/discharge designs and of ambient ocean conditions on recirculation and near-field effluent plume behavior have been investigated by means of physical models. Further study of the intake flow fields may be necessary to make estimates of intake impingement and entrainment effects. Mathematical analysis of intermediate-field mixing of plant effluents has shown that effluent plumes may have vertical dimensions on the order of meters and lateral dimensions on the order of kilometers. Models of oceanic regional and island coastal circulation are required to investigate far-field effects on the scale of tens of kilometers. Basin-wide resource renewal and physical environmental effects are being studied by means of a numerical model of the Gulf of Mexico with detailed vertical resolution. Concerns regarding climatic impacts presently are focused on atmospheric CO_2 loading and modification of air—sea heat exchange processes due to OTEC operation.

52884 (COO—5092/3) **Study of integration issues to realize OTEC market potential. First quarterly report.** (General Electric Co., Washington, DC (USA). Center for Advanced Studies). Dec 1978. Contract EW-78-C-02-5092. 211p. P 10/MF A01.

The specific objective of this study is to examine the commercialization of OTEC technology in the electric utility industry in the Gulf region of the United States. To accomplish this, the project staff is identifying the major issues that will arise in the integration of OTEC units into the power delivery systems in the Gulf Region. Among these issues are problems that must be resolved and barriers to be overcome. These are being identified and alternative approaches to resolving or overcoming them will be explored. Their relative importance in the integration will be assessed as well. The alternative approaches to resolving problems and overcoming barriers will be evaluated to determine their relative effectiveness, and the problems and barriers will be conceptually resolved. This evaluation will permit the recommendation of preferred approaches to integration and the preferred approaches will be assembled into a structured strategy for OTEC commercialization. A list of 134 references relevant to OTEC electric power plant integration issues is included.

52885 (DOE/EA—0062(Vol.1)) **Ocean Thermal Energy Conversion (OTEC) Program. Volume 1. Preoperatinal ocean test platform.** (Department of Energy, Washington, DC (USA)). Mar 1979. 183p. P 09/MF A01.

An environmental impact assessment for the field test of the first preoperational Ocean Thermal Energy Conversion, referred to as OTEC-1, is presented. The conceptual design of OTEC-1 is described, and the existing environments at the four OTEC-1 study sites (Punta Tuna, Keahole Point, offshore New Orleans, and offshore Tampa) are discussed. The environmental impacts considered include organism impingement, organism entrainment, ocean water mixing, metallic ion release, chlorine release, ammonia leakage, oil release, and platform attraction. The development of a risk assessment model for credible accidents at OTEC-1 is discussed. Also, the federal and state legal, safety, and health policies pertinent to OTEC-1 are presented. A glossary is included. (WHK)

52886 (DOE/EA—0062(Vol.2)) **Ocean Thermal Energy Conversion (OTEC) Program. Volume 2. Preoperational ocean test platform.** (Department of Energy, Washington, DC (USA)). Mar 1979. 218p. P 10/MF A01.

The supporting data used to prepare an environmental assessment for the OTEC-1 test facility are presented. The candidate sites (Keahole Point, Hawaii; Punta Tuna, Puerto Rico; offshore New Orleans; and offshore Tampa) are characterized and an annotated bibliography is included for each site. Estimates of the water discharge plume and water suction plume geometry are given. A summary of the calculations used to evoluate the water intake and discharge impact field is presented. An annotated list of applicable health and safety regulations are presented, and a general annotated bibliography of OTEC literature is included. (WHK)

52887 (ORO—5444-1) **Sea-surface temperature variability analysis of potential OTEC sites utilizing satellite data.** Vukovich, F.M.; Crissman, B.W.; Bushnell, M.; King, W.J. (Research Triangle Inst., Research Triangle Park, NC (USA)). Aug 1978. Contract EG-77-C-05-5444. 167p. PC A08/MF A01.

The primary purpose of this research was to perform an analysis of the constancy of the sea-surface temperature in candidate locations for OTEC siting. Most in situ data available to determine the constancy of the sea surface temperature were obtained using point sensors that recorded surface temperature at specific points and at specific times or for some specific period. These data, while establishing certain gross or average patterns, are inadequate for describing short-term temperature variations for large areas and are insufficient for assessing the constancy of the temperature patterns relative to selecting potential sites for OTEC. The only data available for analysis of the synoptic ocean surface temperature pattern are those obtained in the last five years by infrared scanning radiometer systems on earth observational satellites. For this study, the satellite infrared (ir) data for the period 1973-1977 were used to identify and locate major thermal fronts at the sea surface. These data were then used to glean certain statistics on these fronts. In situ data were used, when available, to determine temperature difference across specified thermal fronts. This study was performed in three regional locations of interest to OTEC. The specific regions are: Region I, Eastern Gulf of Mexico (bounded by 22 N to 30 N and 91 W to the west coast of Florida including the Straits of Florida); Region II, the east coast of Florida (bounded by 23 N to 32 N and the east coast of Florida to 79 W); andn Region III, Puerto Rico and vicinity, (bounded by 17 to 19 N, 64 to 68 W). Results are presented and discussed. (WHK)

52888 (SAN—1291-76/1(Pt.A)) **OTEC heat exchanger design and producibility study. Part A. Sections 1 thru 5. Final report.** (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA (USA)). 28 Oct 1976. Contract EY-76-C-03-1291. 171p. (LMSC-D—507632(Pt.A)). P 08/MF A01.

The primary objective of this study is to provide the Energy Research and Development Administration (ERDA) preliminary design plans and specifications for two sets of Ocean Thermal Energy Conversion (OTEC) heat exchangers. The heat exchangers are shell and tube type, and incorporate no heat transfer enhancement mechanism. These heat exchangers consist of evaporators and condensers for a full-scale 25-MW/sub e/ OTEC power plant module and a subscale 5-MW/sub e/ prototype power plant. These plans and specifications may be used by ERDA as the basis for procuring the subscale prototype hardware for test and evaluation of the OTEC concept. The preliminary design effort is carried to a depth sufficient to adequately define a realistic thermal and fluidic design configuration, and to arrive at a credible, producible structural design concept for the heat exchangers. A manufacturing analysis is provided to ensure that a producible design concept has been obtained, and to provide a basis for making preliminary cost estimates of the most promising design configurations. In addition, a hydrodynamic loads analysis was performed to define the structural loads imposed upon the heat exchangers during the various phases of at-sea operation including transit, upending, docking, and submerged operation. A preliminary stress analysis is provided to define realistic structural design criteria, and to identify the principal areas of high stress due to the loading conditions investigated.

52889 (SAN—1291-76/1(Pt.B)) **OTEC heat exchanger design and producibility study. Part B. Appendixes A thru F. Final report.** (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA (USA)). 28 Oct 1976. Contract EY-76-C-03-1291. 328p. (LMSC-D—507632(Pt.B)). P 15/MF A01.

Part of the results of a preliminary design and manufacturing study of 25-MW/sub e/ aluminium-tubed and titanium-tubed heat exchangers and 5-MW/sub e/ subscale heat exchangers for ocean

thermal power plants are presented. Heat transfer studies by the Yuba Heat Transfer Corporation of the evaporator and heat exchanger designs proposed for the ammonia power cycles are summarized. Manufacturing and vendor data on the heat exchangers, Bechtel Corporation comments, and T.Y. Lin International comments are included. An analysis of the sub-scale OTEC heat exchanger loads for conceptual design and specification is presented. Also, the design specifications for an aluminium tubed condenser for a 25-MW/sub e/ OTEC system are defined. (WHK)

52890 (SAN—1291-76/1(Pt.C)) **OTEC heat exchanger design and producibility study. Part C. Appendixes G thru J. Final report.** (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA (USA)). 28 Oct 1976. Contract EY-76-C-03-1291. 273p. (LMSC-D—507632(Pt.C)). P 12/MF A01.

Study results of a preliminary design and manufacturing study of 25-MW/sub e/ aluminium-tubed and titanium-tubed heat exchangers and 5-MW/sub e/ subscale heat exchangers for ocean thermal energy conversion are reported. Subcontractor engineering efforts are described including computer printout sheets from the optimization program; structural analysis of the pressure vessels, heat exchanger tubing, shell to tubesheet transition ring, vapor ports, and concrete pressure vessels; magnaforming of tube-to-tubesheets in aluminium; and explosion bonding and propellant swagging of tubes to tubesheets. (WHK)

SOLAR RADIATION UTILIZATION

REFER ALSO TO CITATION(S) 52754, 52998

52891 (COO—4643-T1) **Continuing Regional Solar Energy Information Mini-Center activities and updating the SOLCOST program. Quarterly report, November 1978—January 1979.** Lantz, L.J. (Solar Environmental Engineering Co., Inc., Fort Collins, CO (USA)). Jan 1979. Contract EG-77-C-02-4643. 31p. P 03/MF A01.

Progress is reported for the following tasks: interactive SOLCOST interface; energy conservation - solar system optimization; detailed duct sizing; extension of the SOLCOST data base; portable FORTRAN version; automatic collector parameter subroutine; the SOLAR INDEX; and the operation of the SOLCOST Mini-Center. Included in the appendix is interactive and portable SOLCOST analysis example. (MHR)

52892 **Saving home energy.** Synder, R. (editor). Denver, CO; Colorado Solar Energy Association (1977). 60p. $4.70.

Guidelines for organizing and conducting a passive solar energy and a hands-on energy conservation workshop are presented in handbook format. The guidelines formed the organizational basis of a Saving Home Energy' workshop sponsored by the Colorado Solar Energy Association. The workshop was divided into sessions on cost-effective information in energy conservation, skills and tools required for home heat conservation, on-site instruction in basic home energy conservation, and dissemination of information on passive solar energy applications. Fundraising schemes for financing the workshop are described, and local businesses that may be approached for monetary and material donations are identified. Guidelines and checklists are presented for workshop registration, publicity, location arrangements, and methods for retaining qualified instructors to run the workshops. Timetables are included for scheduling organization jobs and deadlines, sample fundraising, instructor invitation, thank-you letters, and a questionnaire are reproduced. The formats, objectives, problems, topics, information, and conclusions for each of the four sessions are outlined. Materials required for the on-site work session are listed and methods for selecting on-site locations are reviewed.

52893 (TID—29411) **Continuing Regional Solar Energy Information Mini-Center activities and updating the SOLCOST program. Quarterly report, August—October 1978.** Lantz, L.J.; Winn, C.B.; Leflar, J.A. (Solar Environmental Engineering Co., Inc., Fort Collins, CO (USA)). Oct 1978. Contract EG-77-C-02-4643. 44p. P 03/MF A01.

Progress is reported for the following tasks: interactive SOLCOST interface; energy conservation-solar system optimization; detailed duct sizing; extension of the SOLCOST data base; portable FORTRAN version; automatic collector parameter subroutine; the Solar Index; and the operation of the SOLCOST Mini-Center. Included in the appendices are the following: combined optimization of space heating loads for windows, insulation, doors, etc. and the solar collector area; basis air engineering; and collector parameter modification. (MHR)

52894 **Sun: mankind's future source of energy. Volume Three.** de Winter, F.; Cox, M. (eds.). Elmsford, NY; Pergamon Press Inc. (1978). 826p. (CONF-780114—P3).

From International Solar Energy Congress; New Delhi, India (16 Jan 1978).

Separate abstracts were prepared for approximately 150 included papers. (MOW)

SPACE HEATING AND COOLING

REFER ALSO TO CITATION(S) 52763, 52767, 52967, 52969, 53392, 53393

52895 (ANL—79-8) **HYCSOS: a chemical heat pump and energy conversion system based on metal hydrides. 1979 status report.** Sheft, I.; Gruen, D.M.; Lamich, G. (Argonne National Lab., IL (USA)). Apr 1979. Contract W-31-109-ENG-38. 81p. P 05/MF A01.

The current status of the HYCSOS chemical heat pump and energy conversion system based on metal hydrides is described. Heat transfer fluid loops were insulated and modified for isothermal operation. Software development for HYCSOS manual mode operation was completed. Routines to handle data acquisition, logging, compression, correction and plotting, using a Tektronix Graphics system with flexible disk data storage, provide a rapid and versatile means of presenting HYCSOS data for analysis. Advanced concept heat exchangers to improve the heat transfer of the hydride bed with the heat transfer fluid are discussed. Preliminary tests made with a $LaNi_5$ loaded aluminum foam test unit showed that heat transfer properties are very markedly improved. Thermodynamic expressions are applied to the selection of alloys for use in HYCSOS. The substitution of aluminum for nickel in AB_5 type alloys is shown to reduce hysteresis and permits the use of potentially lower cost materials with added flexibility for the optimization of engineering design and performance characteristics of the hydride heat pump system. Transient thermal measurements on hydride beds of $CaNi_5$ and $LaNi_5$ show no deterioration with cycling. Relatively slow heat transfer between the hydride beds and heat transfer fluid in the coiled tube heat exchangers is indicated by temperature lag of the bed and heat transfer fluid. Improved heat transfer is anticipated with aluminum foam heat exchangers.

52896 (ANL/EES-TM—50) **HYCSOS: chemical heat pump and energy conversion systems based on metal hydrides. Mid-year program report.** Blomquist, C.A. (Argonne National Lab., IL (USA)). Jun 1979. Contract W-31-109-ENG-38. 34p. P 03/MF A01.

The ANL HYCSOS Metal Hydride Chemical Heat Pump Program activities are summarized. Systems engineering, conceptual HYCSOS designs, hydride heat transfer and heat exchanger studies, materials studies, and experimental studies and operations are summarized. The HYCSOS program plan is outlined. (WHK)

52897 (CONF-781142—7) **Status report on the HYCSOS chemical heat pump and energy conversion system.** Gruen, D.M.; Mendelsohn, M.; Sheft, I.; Lamich, G. (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 12p. P 02/MF A01.

From Chemical hydrogen energy systems contracts review; Washington, DC, USA (28 Nov 1978).

An efficient and cost competitive chemical heat pump and energy conversion system driven by solar, other low grade heat sources or by fossil fuels (gas or oil) has been under development at the Argonne National Laboratory since 1975. The HYCSOS concept involves the use of two different metal hydrides with different free energies of formation enabling hydrogen to flow from one to another of the hydrides under the influence of appropriate thermal gradients. In the chemical heat pump mode, hydrogen flows between two pairs of four vessels which take the place of the generator/condenser and evaporator/absorber elements of conventional absorption refrigerators. The functions of generator/absorber and condenser/evaporator are interchanged at the end of each two minute cycle. The chemical heat pump materials are based on the AB_5 alloys which combine a remarkable ability to absorb hydrogen rapidly and reversibly at moderate pressures near ambient temperatures with a large hydrogen storage capacity. The recent development of LaNi/sub 5-x//Al/sub x/ ternary alloys has provided a versatile class of materials whose hydrogen dissociation pressures can be varied in a precisely predetermined manner by almost three orders of magnitude. With these new materials it will be possible to operate the chemical heat pumps over a wide range of preselected temperatures and pressures. The current and prospects for the future development of the HYCSOS system is discussed.

52898 (CONF-790446—5) **HYCSOS chemical heat pump and energy conversion system based on metal hydrides.** Sheft, I.; Gruen, D.M.; Lamich, G.J. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 8p. P 02/MF A01.

From 4. annual heat pump technology conference; Stillwater, OK, USA (9 Apr 1979).

The Argonne HYCSOS system is a two hydride concept, operating as a chemical heat pump for storage and recovery of thermal energy for heating, cooling and energy conversion. Hydrogen gas is transferred from one hydride bed by solar thermal energy input at a characteristic temperature to a second bed where hydrogen is absorbed and thermal energy is released at another tempera-

ture appropriate for the mode of operation in use. The basic HYCSOS concept uses thermal energy from a low grade source such as a solar collector to decompose a hydride, e.g., $CaNi_5$, and the released hydrogen is absorbed at a lower, intermediate, temperature and stored as a second hydride, e.g., $LaNi_5H_6$. The heat pump mode is the low temperature dissociation of the $LaNi_5H_6$ and the absorption of the hydrogen at the intermediate temperature. The intermediate temperature is available for space heating, using solar energy during periods of insolation and using low temperature ambient heat via heat pump action during other times. Operated in a reverse mode, the system can be used for refrigeration, eliminating the mechanical compression required in the operation of a conventional air conditioner. With three hydride heat exchangers containing the same hydride cycling between a high temperature and a lower one, a continuous supply of high pressure hydrogen can be generated to do useful work in an expansion engine-dynamo unit supplying electricity, the hydrogen being absorbed after expansion on the alloy at a lower temperature. The current status of the HYCSOS system is discussed.

52899 (CONF-7804121—(Absts.), pp 17) **Solar space heating.** Packard, C. (Alternative Energy Resources, Inc., El Paso, TX). 1978.

From International solar energy conference and fair; El Paso, TX, USA (13 Apr 1978).

52900 (CONF-7804121—(Absts.), pp 17) **Micro processor control and monitoring of a solar home.** Schroder, D.C.; Tyuluman, S.; Austin, M. (Univ. of Texas, El Paso). 1978.

From International solar energy conference and fair; El Paso, TX, USA (13 Apr 1978).

52901 (CONF-7804121—(Absts.), pp 18) **State of the art of solar cooling.** Vliet, G.C. (Univ. of Texas, Austin). 1978.

From International solar energy conference and fair; El Paso, TX, USA (13 Apr 1978).

52902 (CONF-7804121—(Absts.), pp 18) **Retrofit.** Dowdy, J.A. (Univ. of Texas, El Paso). 1978.

From International solar energy conference and fair; El Paso, TX, USA (13 Apr 1978).

52903 (CONF-7804121—(Absts.), pp 18) **Design for conservation.** Barnhart, C. (Houston Northwest Development Corp., TX). 1978.

From International solar energy conference and fair; El Paso, TX, USA (13 Apr 1978).

52904 (COO—4511-20) **Programmatic support and public information dissemination. Final report, October 1, 1977—December 31, 1978.** Karaki, S. (Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.). Aug 1979. Contract EG-77-S-02-4511. 24p. P 02/MF A01.

Research projects in solar heating and cooling, photovoltaics, and industrial heating, and training programs in solar heating and cooling have been conducted in the CSU/SEAL program. Major accomplishments are: development of a solar heating and cooling system with evacuated tube collectors; determination that solar air heating and liquid heating systems of comparable collector quality have comparable seasonal performance and parasitic power requirements; development of photovoltaic cells of ITO/Silicon that have 10% efficiency; and installation of a commercial scale solar laundry drying facility.

52905 (DOE/CS—0089) **National Program Plan for Passive and Hybrid Solar Heating and Cooling. Interim report.** (Department of Energy, Washington, DC (USA). Office of Conservation and Solar Applications). Jun 1979. 132p. P 07/MF A01.

The National Program Plan for Passive Solar Heating and Cooling consists of four major parts. The first part describes the planning context. A definition of a passive solar system is given, as well as a background of Federal involvement in passive solar heating and cooling, program goals and objectives, and an overall implementation approach. The second part addresses the technology development program area. Background information on the status of and the strategy and emphasis for technology development is provided, followed by descriptions of passive heating and passive cooling systems and an overview of task classifications for technology development. The third part describes the technology utilization program area. Again, background information is given on the status of and the strategy and emphasis for technology utilization. This is followed by a narrative description of the technology utilization process and an overview of task classifications for technology utilization. The fourth part (Appendices) provides detailed information on the tasks and schedules. Appendix A contains brief descriptions of the technology development tasks. Appendix B presents system development schedules for promising passive solar heating and cooling systems selected for intensive development activity. Appendix C contains brief descriptions of the technology utilization tasks. Appendix D presents schedules for utilization tasks selected for near-term implementation. Appendix E presents the projected energy impact of passive solar space-heating of residences and light commercial buildings.

52906 (DOE/NASA/CR—161237) **Solar heating, cooling, and hot water systems installed at Richland, Washington. Final report.** (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). Jun 1979. Contract EX-76-A-29-1037;EX-76-C-01-2404. 233p. P 11/MF A01.

Project Sunburst is a demonstration system for solar space heating and cooling and solar hot water heating for a 14,400 square foot office building in Richland, Washington. The project is part of the US Department of Energy's solar demonstration program, and became operational in April 1978. The solar system uses 6,000 square feet of flat-plate liquid collectors in a closed loop to deliver solar energy through a liquid—liquid heat exchanger to the building heat-pump duct work or 9,000-gallon thermal energy storage tank. A 25-ton Arkla solar-driven absorption chiller provides the cooling, in conjunction with a 2,000 gallon chilled water storage tank and reflective ponds on three sides of the building to reject surplus heat. A near-by building is essentially identical except for having conventional heat-pump heating and cooling, and can serve as an experimental control. An on-going public relations program has been provided from the beginning of the program and has resulted in numerous visitors and tour groups.

52907 (LBL—8606(DRAFT)) **Draft interim report: National Program Plan for Passive Solar Heating and Cooling.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1978. Contract W-7405-ENG-48. 129p. P 07/MF A01.

The National Program Plan for Passive Solar Heating and Cooling consists of four major parts. The first part describes the planning context. A definition of a passive solar system is given, as well as a background of Federal involvement in passive solar heating and cooling, program goals and objectives, and an overall implementation approach. The second part addresses the technology development program area. Background information on the status of and the strategy and emphasis for technology development is provided, followed by descriptions of passive heating and passive cooling systems and an overview of task classifications for technology development. The third part describes the technology utilization program area. Again, background information is given on the status of and the strategy and emphasis for technology utilization. This is followed by a narrative description of the technology utilization process and an overview of task classifications for technology utilization. The fourth part (Appendices) provides detailed information on the tasks and schedules. Appendix A contains brief descriptions of the technology development tasks. Appendix B presents system development schedules for promising passive solar heating and cooling systems selected for intensive development activity. Appendix C contains brief descriptions of the technology utilization tasks. Appendix D presents schedules for utilization tasks selected for near-term implementation. Appendix E presents the projected energy impact of passive solar space-heating of residences and light commercial buildings.

52908 (PNL—2972) **Some potential material supply constraints in solar systems for heating and cooling of buildings and process heat. A preliminary screening to identify critical materials.** Watts, R.L.; Gurwell, W.E.; Nelson, T.A.; Smith, S.A. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1979. Contract EY-76-C-06-1830. 140p. P 07/MF A01.

Nine Solar Heating and Cooling of Buildings (SHACOB) designs and three Agricultural and Industrial Process Heat (AIPH) designs have been studied to identify potential future material constraints to their large scale installation and use. The nine SHACOB and three AIPH systems were screened and found to be free of serious future material constraints. The screening was carried out for each individual system design assuming 500 million m^2 of collector area installed by the year 2000. Also, two mixed design scenarios, containing equal portions of each system design, were screened. To keep these scenarios in perspective, note that a billion m^2 containing a mixture of the nine SHACOB designs will yield an annual solar contribution of about 1.3 Quads or will displace about 4.2 Quads of fossil fuel used to generate electricity. For AIPH a billion square meters of the mixed designs will yield about 2.8 Quads/year. Three materials were identified that could possibly restrain the deployment of solar systems in the specific scenarios investigated. They are iron and steel, soda lime glass and polyvinyl fluoride. All three of these materials are bulk materials. No raw material supply constraints were found.

52909 (SAND—78-8824) **Development and testing of the sulfuric acid-water Chemical Heat Pump/Chemical Energy Storage system.** Hiller, C.C.; Clark, E.C. (Sandia Labs., Albuquerque, NM (USA); Rocket Research Corp., Redmond, WA (USA)). Jul 1979. Contract EY-76-C-04-0789. 5p. (CONF-790803—35). P 02/MF A01.

From 14. intersociety energy conversion conference; Boston, MA, USA (5 Aug 1979).

The Sulfuric Acid-Water Chemical Heat Pump/Chemical Energy Storage (CHP/CES) system is the first of several such solar heating and cooling systems being developed under US Department of Energy (DOE) funding which has been successfully demonstrated on a meaningful scale. Principles of operation, preliminary economics, and testing of a prototype unit of normal 25,000 to 35,000 Btu/hr (7 to 10 KW) capacity are discussed.

52910 (SAND—79-0824) **Passive solar buildings.** (Sandia Labs., Albuquerque, NM (USA)). Jul 1979. Contract EY-76-C-04-0789. 285p. P 13/MF A01.

The description, successful operation, and performance estimate for each of 15 passive solar heated buildings are given. Technical evaluation methods and general economic factors are also considered.

52911 (SERI/TP—34-187) **Overview of developing programs in solar desiccant cooling for residential buildings.** (Solar Energy Research Inst., Golden, CO (USA)). 1979. Contract EG-77-C-01-4042. 18p. (CONF-790678—3). P 02/MF A01.

From ASHRAE society meeting; Detroit, MI, USA (24 Jun 1979).

An overview is provided of the ongoing work in desiccant cooling under the national solar heating and cooling research program. Open cycle adsorption and absorption systems are examined. The different dehumidifier bed configurations are the distinguishing features of these systems. The basic operating principles of each dehumidifier concept are explained along with some discussion of their comparative features. Performance predictions developed by SERI for a solar desiccant solar system employing an axial-flow desiccant wheel dehumidifier are presented. In terms of life-cycle cost and displaced fossil-fuel energy, the results indicate that it should be beneficial to use solar desiccant coolers in residential applications. Although no prototype testing of any of these concepts is currently underway, test results are expected and will be reported within one year.

52912 (SIB-D—16-1978) **Swedish central solar heating plant for 2000 dwellings: a feasibility study.** Margen, P.; Perers, B.; Spangberg, K.G. (Statens Inst. foer Byggnadsforskning, Stockholm (Sweden)). 1978. 27p. U 03/MF A01.

The first phase of a feasibility study concerning the application of solar heating to larger isolated housing schemes is described. Load projections, distribution systems, systems with and without heat pumps, solar heat station design, performance calculations, overall costs, and influence of cost assumptions are discussed. (MHR)

52913 (SOLAR/2004—79/50) **Solar project description for Trinity University Power Plant No. 2.** Hale, H.J. (PRC Energy Analysis Co., McLean, VA (USA)). 8 Sep 1978. Contract EG-77-C-01-2522. 56p. P 04/MF A01.

This solar system in San Antonio, Texas is used for space heating, cooling, and hot water for six 500-student dormitories and an athletic complex for a total floor space of about 285,000 ft^2. The overall concentrating collector area is about 16,080 ft^2. Two 20,000 storage tanks are used for thermal storage. A solar-power 352 ton absorption chiller is used for space cooling. A three-cell ceramic cooling tower rejects heat from the condenser water. The auxiliary energy system consists of a 405 hp natural gas boiler, a 623 ton electric centrifugal chiller, and the cooling tower. The solar energy system has been fully instrumented for thermal performance and integrated into the National Solar Data network. The system has been operational since June 1977. (MHR)

52914 Self-supporting active solar energy system. Zakhariya, R.H. US Patent 4,147,157. 3 Apr 1979. Filed date 25 May 1977. 4p.

An active solar energy system is disclosed comprising an array of solar collectors, a pumping device to circulate fluid therethrough and a storage tank to contain the heated fluid. The pump is driven by an electric motor and a solar-electric power transducer system energizes the motor, whereby the fluid is circulated through the collector system whenever sunlight is available. The heated fluid from the collector array, as well as the unheated fluid from the source are delivered to a mixing vessel from which the mixture fluid is delivered to a storage tank to meet demands.

52915 Heat pump design: cost-effectiveness in the collection, storage and distribution of solar energy. Cottingham, J.G. (Brookhaven Natl Lab, Upton, NY). *ASHRAE J.;* **21**: No. 4, 35-48(Apr 1979).

Various solar heat pump configurations are reviewed, and the assisted or series configuration is identified as the concept having the greatest potential for economic acceptance. This study examines the system impact that would result from the development of vapor compression equipment specially tuned to the collection and distribution of solar energy. Major impacts on the solar collector and energy storage elements are identified and reviewed.

52916 Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978). 725p. (CONF-7808105—P1). SESCI 1978 Conference, P.O. Box 2220, Station A, London, Ontario, Canada.

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

Abstracts were prepared for each of the approximately 100 papers. Several of the papers were entered into the EAPA data base. (MOW)

52917 Saskatchewan Conservation House: some preliminary performance results. Besant, R.W.; Dumont, R.S.; Schoenau, G. (Univ. of Saskatchewan, Saskatoon). pp 3.1.2.1-3.1.2.17 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

The Saskatchewan Conservation House, a low energy consumption solar heated residential structure, began operation in December, 1977. Monitoring of the house began in January, 1978. The house has been operated as a demonstration dwelling seven days a week, and consequently monitoring conditions have been less than ideal, with approximately 1000 visitors per week passing through the house. Monitoring of the energy consumption of the dwelling indicates that the design objective - a heat loss rate of 81 watts per degree Celsius temperature difference between outside and inside - has been met and exceeded. An average Regina house has a heat loss rate of approximately 250 watts/°C. The solar system uses 17.8 sq m of vacuum tube collectors. As the solar system was not started until mid-December, 1977, it was not possible to provide 100% solar heating during this winter period. Approximately 3 gigajoules of thermal energy can be stored in the 12,700 litre storage tank. Based on the measured performance of the house, a space heating requirement of 5.2 gigajoules per year (4.9 million Btu per year) would be needed to heat the house under normal occupancy conditions. The solar system is designed to provide 100% of this space heating requirement.

52918 Report on a survey of operational solar systems. Lorriman, D. (Raymond Moriyama, Architects and Planners, Toronto, Ontario). pp 3.1.3.1-3.1.3.8 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

During the winter and spring of 1978, a study was undertaken for the National Research Council to survey operational solar systems in North America - especially those operating in climates similar to Canada's. The purpose of the survey was to learn from the experiences gained from these systems and to report on any problems that may have developed in order to identify areas that require further research. Although the collector component of the systems received the most attention, other parts of the systems were also considered. The survey included a literature review, a mailed questionnaire programme and site visits to over 60 installations. This paper will summarize the findings of the survey.

52919 NRC Solar Monitoring Program. Barakat, S.A.; Carscallen, W.E.; Sibbitt, B.E. (National Research Council of Canada, Ottawa, Ontario). pp 3.1.4.1-3.1.4.14 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

As part of the federal solar heating program, the Division of Building Research of the National Research Council is responsible for an on-going monitoring program of various solar installations. The aims of the program are to determine the solar contribution to the heating needs of buildings, to provide technical data for validating solar system simulation design methods and to permit analysis of subsystem performance. The paper describes the different levels of monitoring used by NRC and lists the buildings in which these monitoring systems are or will be installed. In particular, a description is given of the monitoring equipment installed in twelve federally-funded solar heated homes, as well as their installation and calibration. Some of the problems associated with the monitoring systems are also discussed.

52920 Performance of the Meadowvale solar home. Sibbitt, B.E. (National Research Council of Canada, Ottawa, Ontario); Jung, H.; Lorriman, D. pp 3.1.6.1-3.1.6.10 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

Monitoring of the Meadowvale Solar Experiment in Mississauga, Ontario, began in October 1976 and has continued to date. The paper presents a performance summary of monitoring results of the first two complete heating seasons of solar system operation. Data for the period from October 1976 through April 1978 show that the solar system provided 51% of the space heating requirement, 14% of the service-water heating requirement, and that 54% of collected energy was lost from storage. The paper also contains

brief descriptions of the solar system, the house and the monitoring system.

52921 Off-peak electrical backup experience in the Meadowvale Solar Experiment. Bell, J.M. (Ontario Hydro, Toronto); Lorriman, D. pp 3.1.7.1-3.1.7.11 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

The paper describes the design and operation of the off-peak backup system and contains suggestions for improvements. A comparison is made of the electrical demand and consumption for 1976—1977 (on-demand electrical backup) to 1977—1978 (off-peak electrical backup). The electrical load curve of the house is described and compared with the Ontario Hydro system load curve with a brief discussion of the potentials and the drawbacks of the use of off-peak power. Reference is made to other work programs in this area.

52922 Performance of a site built, air heating, vertical collector with snow reflector in Quebec. Kerr, R.G.; Shapiro, M.M. (Concordia Univ., Montreal, Quebec). pp 3.1.10.1-3.1.10.12 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

A screen-type vertical air heating collector with double glazing was installed in 1975 as the south wall of a house near La Macaza, Quebec, 170 km north of Montreal. The collector was built on site, using normal construction materials, for a gross cost of $70/sq m, and a net cost of $45/sq m, in 1975 dollars. The house and solar heater were monitored during the 1976—1977 heating season. The noon efficiency curve of the collector compares favorably both with that of an experimental and with that of a factory-built collector. The monthly average efficiencies ranged from 32% in March to 42% in October. The ratio of solar heat to the sum of solar and baseboard heat supplied ranged from 0.29 in November to 0.76 in March, and was 0.5 over the entire heating season. Daily and monthly solar radiation and solar heat collected, plus monthly average efficiencies and solar fraction are presented.

52923 Allowable costs for alternative domestic heating systems using utility supplied electricity for backup or charging energy. Barnstaple, A.G.; Drewes, P.L. (Ontario Hydro, Toronto). pp 5.1.1.1-5.1.1.15 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

This paper outlines the results of an Ontario Hydro study which determines the economic potential for development of various alterative heating systems from their projected electric demand characteristics. The economic potential for each system is derived through comparison of total utility plus homeowner costs with conventional electric heating.

52924 Component cost of solar energy systems. Orgill, J.F.; Higgin, R.M.R. (Ontario Ministry of Energy, Queen's Park). pp 5.1 3.1-5.1.3.17 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

The Solar Demonstration Program is a key element of the Ontario Ministry of Energy Renewable Energy Program. Under the demonstration program a number of residential and commercial/institutional projects have been designed and constructed and are becoming operational. The cost information from a variety of projects based on actual tender prices is presented and will assist in estimating costs for future projects. Recent cost data from the United States Commercial Solar Demonstration Program Cycle II are also presented for comparison and future trends in costs are discussed, based on work by the MITRE Corporation in the US. Problems that have been encountered in the tendering of solar projects are outlined with suggestions on how to avoid these in future projects.

52925 Design study on solar energy systems for commercial buildings. Bisset, J.B.; Monaghan, P.F. (Chorley and Bisset Ltd., London, Ontario). pp 6.1.2.1-6.1.2.12 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

This paper summarizes the results of a design study on the solar heating and cooling of an 11 story, downtown office building in Ottawa. The objectives of the study were: (1) to develop system design concepts for utilizing solar energy in commercial buildings; and (2) to establish accurate capital cost information. Five system concept designs were developed.

52926 Designing solar heating for Canadians. Hollick, J.C. (Conserval Engineering Inc., Downsview, Ontario). pp 6.1.3.1-6.1.3.5 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

As most solar system designs originated in warm climates, this paper will stress design considerations necessary for simple, low cost, and low maintenance solar heating systems geared to the Canadian climate. The use of snow to increase solar heating efficiency will be covered. Two installations will be discussed in detail, one a privately funded do-it-yourself air system which has been operating since the summber of 1977 and has provided 100% solar heat for a greenhouse and 50% solar heat for the house. The low capital cost of $2,000 for this installation will be discussed. The second system is a government-sponsored project at Lagoon County which uses air panels to heat the domestic water supply. This system is scheduled for completion during the summer of 1978. Air collectors have certain advantages over a liquid collector and these advantages will be explained. Photos will be used to illustrate both systems.

52927 Solar energy retrofit system for an older-type building: the Williamstown Museum Project. McKiel, G.; Broomhall, E. (John Abbott Coll., Ste. Anne de Bellevue, Quebec). pp 6.1.4.1-6.1.4.13 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

The museum, circa 1862, is a two-story, solid brick schoolhouse, 70 x 30 ft. Subsequent to heat loss calculations and air infiltration analysis an air solar heating system was designed by Glengarry Energy Alternatives and Renewable Sources, Inc. (G.E.A.R.S., Inc.). The system is comprised of approximately 1000 ft^2 of back pass, flat plate solar collectors and 384 ft^3 of containerized water storage. This paper describes the design, fabrication, installation and problems encountered during the onsite construction of one of Canada's largest solar installations.

52928 Solar heating and ventilation by the modified Trombe wall system. Bilgen, E.; Chaaban, M. pp 6.1.5.1-6.1.5.7 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978). (In French)

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

This article presents the first stages of a theoretical and experimental study of the modified Trombe wall. It is well known that the Trombe wall collector processes a large thermal inertia and, as a result, performs several functions: to capture the solar energy, to feed the room with one part of this energy by heat circulation, and to store the rest in its own thermal mass. A major problem with this system is the great loss of energy during the night, since only the glass resistance opposes the escape to the outside of the heat stored in the wall. The object of this study is to examine the possibility of eliminating this disadvantage by separating the capture from the storage. A simple collector of small thermal inertia insulated from the interior is utilized. This system is presently subject to an experimental study in the solar laboratory of the Ecole Polytechnique SOLAB, and the analytical study is in progress.

52929 South wall solar collector with active collector system. Linton, K.J. (Ontario Government, Toronto). pp 6.1.7.1-6.1.7.8 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

The south wall of the building is constructed to act as a solar air collector. The collector system operates in conjunction with an air to water heat pump and water storage to collect the excess solar heat received. The heat pump extracts heat from the water storage to heat the house when this is required.

52930 Solar assisted warehouse heating systems. Adsett, E.E. (New Brunswick Electric Power Commission, Fredericton). pp 6.1.8.1-6.1.8.11 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

The New Brunswick Electric Power Commission has completed the construction of two solar heated warehouses in Bathurst, N.B. The solar heating system designs emphasize minimum initial investment and the use of already required building components. The collectors are also the south facing walls while thermal storage consists of a block wall partition and the warehouse storage components themselves. The only materials required to install the solar heating system are two layers of fiberglass reinforced plastic glazing, ductwork, and in-duct fan, and associated controls. Building floor areas are 3000 and 8000 square feet. Collector areas are 800 and 1400 square feet.

52931 WATSON: a simulation program for solar-assisted heating systems. Chandrashekar, M.; Hollands, K.G.T.; Le, N.T. (Univ. of Waterloo, Ontario). pp 7.1.1.1-7.1.1.12 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

WATSUN, a generalized computer program, developed at the University of Waterloo, is being used as a design tool to evaluate the technical and economic performance of solar heating systems. It is capable of simulating three types of systems: air-based system with short term storage, liquid-based systems with short term storage and annual storage. A revised version, called WATSUN-II, is also available for simulating solar assisted heat pump systems at different locations across Canada. Using hourly meteorological data, simulations are carried out for different locations, building types, varying parameters, such as collector area, storage volume and heat pump capacity. Computer output includes the monthly and yearly energy consumption for various system alternatives. A life-cycle economic analysis is performed to compare their cost effectiveness over the reference systems such as conventional heating systems and an air-to-air heat pump.

52932 Validation of an electric circuit model of a solar house. McConnell, R.D. (IREQ, Varennes, Quebec); Kerr, R.G.; Shapiro, M.M. pp 7.1.2.1-7.1.2.12 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

Meteorological, electrical and temperature measurements were recorded at fifteen minute intervals during the 1976--1977 heating season in a solar house located near the village of La Macaza, Quebec. A computer model was developed which simulates the house and its solar heating system. Thermal resistances are modelled by electric resistors, solar radiation by a current source, temperatures by electric voltages and thermal storage units by electric capacitors. A validation of the electric circuit model is described in which the responses of the model, to incident solar radiation, ambient temperature, and internal heat generation data, are compared with the recorded temperatures in the collector, in the solar storage unit and in the house, during four-day periods in February, 1977. Reasonable agreement is found.

52933 Mathematical modelling of passive solar systems. Carter, C. (Trent Univ., Peterborough, Ontario). pp 7.1.3.1-7.1.3.12 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

Passive Solar Systems have several features which often make it possible to use simple mathematical models to describe them. Firstly, temperature differences are small so that linear models can be used to represent heat transfer by radiation and convection as well as by conduction. Secondly, we are often interested in periodic thermal variations in which the co-efficients of the linear model are constants. In such cases, the overall thermal input into the system over a complete time cycle is given by a simple stationary state model and may be calculated with considerable accuracy, even when the model may perhaps not describe the detailed time variation very adequately. Thirdly, the thermal storage and thermal insulation media are almost distinct, (e.g., foam insulation on the outside of a concrete wall) so that otherwise complicated heat transfer problems can be greatly simplified. The implications of these three features are explored in some detail, and applied to obtain a mathematical description of the (Trombe) Solar Wall. The performance of a solar wall is compared with that of a south facing window in a thermally solid building.

52934 Application of solar principles in the design and construction of the alternate energy shelter. Lee, T.G. (Univ. of Calgary, Alberta). pp 8.1.1.1-8.1.1.10 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

The success of this solar heated shelter can be attributed to the enthusiasm and joint efforts of the community, business, and the university, involved with its construction last summer. Its public educational and business promotional benefits are described in Update '77 Proceedings. This paper addresses the application of design criteria and methodologies of constructing this shelter. A multitude of parameters have been identified and accomodated in its design. They include the use of non-skilled and casual laborers, unique site constraints, availability of materials, economics, scope of the project, code restrictions, and so on.

52935 Solar energy and the native community: a strategy for autonomy. Riordan, J.M. (J.M. Riordan and Associates, Toronto, Ontario). pp 8.1.5.1-8.1.5.10 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

This paper is based on a report submitted to the Royal Commission on Electric Power Planning entitled Renewable Energy Systems and Technology - Feasibility and Application to the Serpent River Indian Reserve. The study examined the potential for the solar space heating of a single family unit and the passive collection of solar energy for an agricultural building in the native milieu. Solar greenhousing; aquaculture; agriculture; wood energy as an auxiliary system and a small scale solar energy systems manufacturing plant are each explored as components of the overall appropriate technology strategy for the autonomy of native communities. The advantages of co-operative approaches to the development and subsequent utilization of renewable energy systems are also considered. How the particular community studied relates to nuclear energy technology and other energy industries is essential to this presentation. The reasons for this native community's examination and consideration of renewable energy alternatives will become increasingly evident as the seminar progresses. This paper will be of particular interest to those concerned with the feasibility of the application of solar energy technology beyond 46 degrees N.

52936 Passive solar heating: results from two Saskatchewan residences. Dumont, R.S. (Univ. of Saskatchewan, Saskatoon); Besant, R.W.; Jones, G.; Kyle, R. pp 8.3.1.1-8.3.1.17 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

Quantitative measurements of the performance of two residences incorporating passive solar design principles are presented. One structure used 32.5 square metres of quadruple glazed south facing windows in a structure with an overall building heat loss factor of approximately 250 W/°C. The second structure (the Saskatchewan Conservation House) used 11.7 square metres of double-glazed south facing glazing with operable night-time shutters, with an overall building heat loss factor of 100 W/°C (shutters open) and 70 W/°C (shutters closed). Both houses were of the direct solar gain type, with no vertical thermal mass such as a Trombe Wall directly behind the glazing.

52937 Measured and modeled passive performance in Montana. Palmiter, L.; Caswell, W.; Corbett, R.J. (National Center for Appropriate Technology, Butte, MT). pp 8.3.2.1-8.3.2.9 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

Several passive solar test units have been constructed at the National Center for Appropriate Technology. The design, instrumentation and performance of the direct gain and Trombe wall cells are discussed. Preliminary results of a simple computer model for simulating air and storage wall temperatures are presented.

52938 Groundhouse, a low cost solar home. Wistinghausen, N. pp 8.3.4.1-8.3.4.5 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

A drastically new concept of home construction, which is far more economical, safer, more weather resistant, and saves lots of energy is presented. Soil and sun are used to cool it or heat it. Excavated earth from the basement is piled up on top and three sides for insulation, then landscaped. The U-shaped concrete and steel structure features a private court yard for light, a hydroponic integral greenhouse for fresh vegetables all year, and solar panels on the greenhouse for heat. A long range heat storage below the living room offers warmth even when the power has failed. One wall between kitchen and bathroom features short runs of all the plumbing required. Interior bedroom walls are moveable to adjust room sizes. Simplicity prevails throughout. Mainteinance is cut to a minimum. High winds and vandals can't harm it, and handy couples could build the groundhouse themselves at one quarter the price.

52939 Integration of a passive and active solar heated, low density, multiple dwelling with atrium. Lee, T.G. (Univ. of Calgary, Alberta); Jenkins, D.H. pp 8.3.5.1-8.3.5.14 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

The Rundlehorn Solar Heated Townhouse incorporates varying heights and non-identical units which wrap around an enclosed atrium. The atrium conserves heat energy by decreasing exterior wall surfaces, providing the tenants with a year-round garden, and collecting both active and passive solar heat. The three stories on the north and two stories to the south optimize solar orientation. The double glazed atrium roof conserves heat energy by a large, uniquely designed insulating shutter. Solar heat is collected by a site-built air

collector on the north wall of the atrium. The collected heat is ducted to a large insulated rock storage bin under the atrium. Computer simulation predicted this will contribute approximately 42% of the heat energy required to the units. An active domestic hot water preheat system which will provide 71% of the energy is also incorporated. Unique in its design are the two storage tanks used to increase collector efficiency. For comparative purposes an identical complex is to be built close by but without the solar components and glazing over the atrium.

52940 Renewable alternatives. Volume 2. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978). 275p. (CONF-7808105—P2). SESCI 1978 Conference, P.O. Box 2220, Station A, London, Ontario, Canada.

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

Separate abstracts were prepared for the eighteen included papers. (MOW)

52941 First year performance data and lessons learned in the NRC 14 house solar demonstration program. Carscallen, W.E.; Sibbitt, B.E. (National Research Council of Canada, Ottawa, Ontario). pp 3.1.5.1-3.1.5.14 of Renewable alternatives. Volume 2. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

During 1976—1977, the NRC funded the design and installation of fourteen active solar space heating systems in single family homes as part of its solar demonstration program. Both air and liquid based systems were installed on new and existing dwellings. A description of the houses and systems is provided, as well as a limited performance summary of six of these houses. Problems associated with the design, construction, and operation of the project houses are also discussed.

52942 Alternate energy installations on the Jordan College campus. Coxon, L.K. (Jordan College, Cedar Springs, MI). pp 3.1.11.1-3.1.11.8 of Renewable alternatives. Volume 2. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

Since planning its first solar installation in 1974, Jordan College has constructed five alternate energy demonstration units which contribute greatly to reducing energy expenses. The two largest solar heating units range in collector size from 1,000 square feet to 2,080 square feet while a retrofitted student residence has approximately 340 square feet of collector. Costs for the installations range from $1200 for a low technology retrofit application to $138,000 on a US Department of Energy demonstration project using sophisticated technology and prebuilt apparatus. Solar heated air for the heating of space and solar heated water for both space and domestic hot water applications are utilized on the campus, both separately and jointly.

52943 Determination of the potential for solar retrofitting in Edmonton. McLaughlin, J.F. (Univ. of Alberta, Edmonton). pp 6.1.9.1-6.1.9.12 of Renewable alternatives. Volume 2. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

The paper focuses on the methodology adopted for a pilot study which is currently being undertaken in Edmonton to determine the potential for adding active solar energy systems onto existing single family dwellings. Of particular importance is the sampling procedure, and the field methods utilized. Preliminary results and analysis are presented for one of the four neighborhoods selected for surveying. This neighborhood, Garneau, was constructed during the period 1946 to 1959. While over one half of the homes in the Garneau sample have south-facing roofs, many of these have limited or poor retrofit potential for roof collectors due to construction and shading problems. Alternative collector locations on the properties are also briefly discussed. The technical problems of mounting solar panels onto existing structures and integrating the solar assist system into conventional hot water and space heating systems are presented in chart form.

52944 Setting up a solar workshop in rural Iran. Alward, R. (National Center for Appropriate Technology, Butte, MT); Mansoor, H. pp 8.1.3.1-8.1.3.12 of Renewable alternatives. Volume 2. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

The setting up and operation of a small scale workshop for developing and adapting solar energy systems suitable for construction in rural areas of western Iran are described. The workshop was conceived as an integral part of an overall program which is attempting to foster village and marginal community development along sustainable ecological and economic lines. This operational workshop has education, experimental and research elements to it in addition to the more routine technical activities normally associated with small production oriented shops. Several of the systems developed in the shop during 1977 are described, as is the relevance of each in the overall community development program. Projects included are solar air and water heaters, dryers and cookers. A description is provided of a limited production run of 16 modular size solar heaters, including plans and photographs.

52945 (LA-UR—79-2025) **Passive solar economics in 15 northwest locations.** Kirschner, C.; Ben-David, S.; Roach, F. (Los Alamos Scientific Lab., NM (USA); New Mexico Univ., Albuquerque (USA)). [nd]. Contract W-7405-ENG-36. 6p. (CONF-790845—1). P 02/MF A01.

From Solar 79 Northwest conference; Seattle, WA, USA (10 Aug 1979).

The economic performance of Trombe wall and direct gain passive solar heating designs are evaluated using the LASL/UNM solar economic performance code. Both designs are integrated into a ranch style tract home concept thereby facilitating intra-regional comparison. The economic performance of these systems is evaluated for 15 sites in the Northwest region. Space heating loads have been locally specified. System sizes have been optimized against the natural gas and electric resistance heating alternatives, the current price and future escalation of which is established for each locale. Sensitivity analysis is conducted to determine the maximum competitive add-on costs for each system under a specified set of energy price, solar performance and economic conditions.

AGRICULTURAL AND INDUSTRIAL PROCESS HEAT

REFER ALSO TO CITATION(S) 52904, 52905, 52907, 52908, 52962

52946 (CONF-7804121—(Absts.), pp 19) **Solar energy impacts in agriculture.** Martin, R.S. (New Mexico State Univ., Las Cruces). 1978.

From International solar energy conference and fair; El Paso, TX, USA (13 Apr 1978).

52947 (SERI/TP—34-236) **Applications analysis for the solar industrial process heat market.** Stadjuhar, S. (Solar Energy Research Inst., Golden, CO (USA)). 1979. Contract EG-77-C-01-4042. 16p. (CONF-790459—3). P 02/MF A01.

From Instrument Society of America, Pittsburgh modeling and simulation conference; Pittsburgh, PA, USA (25 Apr 1979).

The importance of the industrial process heat market in terms of energy consumption and amenability of this market to solar thermal technology are examined. An analytical method for evaluating solar industrial process heat systems has been developed and implemented in a flexible, fast calculating, computer code - PROSYS/ECONMAT. The long-term average performance model PROSYS predicts annual energy output for several collector types, including flat-plate, non-tracking concentrator, one-axis tracking concentrator, and two-axis tracking concentrator. The companion computer program ECONMAT calculates the solar equipment cost and generates a life cycle cost analysis. Analytical results demonstrate the software flexibility for use in feasibility and parametric sensitivity studies.

52948 Use of solar energy in curing tobacco. Drewes, P.L.; Heath, D.B. pp 4.1.1.1-4.1.1.10 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

During 1977 the authors financed, constructed and operated a demonstration project aimed at determining the feasibility of using heat collected in a greenhouse to cure tobacco. The basic idea behind this experiment is simply to use existing equipment, namely the greenhouse, as a solar collector to provide supplementary heat to the existing tobacco kilns. A previous study by the authors indicated that such a system could save approximately $800 in fuel costs per curing season for the average tobacco farm. This paper summarizes the first year's experience with this solar assisted curing system and discusses some of the energy demands of the tobacco curing process.

52949 Solar assisted heat exchanger for livestock shelters. Besant, R.W.; Schoenau, G.J.; Dumont, R.S. (Univ. of Saskatchewan, Saskatoon). pp 4.1.2.1-4.1.2.5 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

In well insulated livestock shelters almost all of the heating load is due to energy required to heat ventilating air. This paper describes an efficient low cost air-to-air heat exchanger for heat recovery in livestock buildings. A solar collector which constitutes an integral part of the design is used to preheat the outdoor air entering the heat exchanger. The primary materials of construction are plywood and polyethylene and the design is simple enough that the heat exchanger can be constructed by the user. Preliminary

evaluation during the past winter (1977—1978) indicates that the energy savings in one year are enough to more than pay for the construction costs, including both material and labor.

52950 Introduction of solar dryers in rural Iran. Alward, R. (National Center for Appropriate Technology, Butte, MT); Mansoor, H. pp 4.1.4.1-4.1.4.10 of Renewable alternatives. Volume 2. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

The authors describe their work in Iran with a small farm application of a passive solar dryer. Included is the rationale for a solar drying program in the region under consideration. The construction of a solar dryer and experimental results in drying typical fruits are described. The process of introducing the dryer, the adaptations necessary to conform to the needs of a farmer and a preliminary evaluation of the dryer are also included. The methods of introducing this technical change are evaluated within the context of an appropriate technology approach.

52951 Energy for worldwide agriculture. Stout, B.A.; Myers, C.A. (Michigan State Univ., East Lansing). pp 4.1.6.1-4.1.6.12 of Renewable alternatives. Volume 2. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

A summary of a new book of the same title is given. This comprehensive manual is designed to put energy use in agriculture in perspective. Energy resources are tabulated and the principles and efficiency of various conversion processes are discussed along with their applications in the food system. Energy flow in the food system and energy requirements for each operation in production, processing and delivery are also presented.

WATER HEATING

REFER ALSO TO CITATION(S) 52767, 52905, 52906, 52907, 52908, 52913, 52944, 52967, 53015

52952 (SOLAR/1017—79/50) **Solar project description for Facilities Development Corporation's Condominium, San Diego, California.** Moore, D. (Boeing Co., Huntsville, AL (USA)). 7 May 1979. Contract EG-77-C-01-4049. 42p. P 03/MF A01.

This solar system is designed to provide preheated water to 31 individual domestic hot water tanks for the 31 unit condominium development. The system has 524 square feet of double glazed flat plate collectors. Potable water is the heat transfer medium to the 1,000 gallon buried storage tank. The site, building, system, and performance evaluation instrumentation are described. Original cost estimates for provisioning and installation of the solar system are given. (MHR)

52953 Apparatus for solar hot water system and method of making same. Goolsby, P.F. (to Reynolds Metals Co.). US Patent 4,153,043. 8 May 1979. Filed date 31 Oct 1977. 10p.

Apparatus for heating and maintaining the temperature of water in a hot water tank of a solar hot water system and method of making same are provided wherein such apparatus comprises a thermally insulating container disposed around and in spaced relation from the tank with the container having a bottom portion defining a sump for a heat transfer liquid employed in the system and a device for maintaining the level of such liquid in the sump beneath the tank during normal system operation to thereby assure maintenance of an air space substantially completely around the tank with the air space cooperating with the insulating container to assure the temperature of water in the tank is maintained with minimum loss; and, the apparatus may also employ a pressure sensitive shut-off device in the cold water supply to the tank which cooperates with the air space to assure operation of the system with substantially no likelihood of contamination of the cold water supply.

52954 Measured and predicted performance of solar domestic water heaters. Bell, J.M.; Strack, J.T. (Ontario Hydro, Toronto). pp 3.1.8.1-3.1.8.15 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

Solar water heating offers good potential for the conservation of electricity in Ontario, since about half of existing water heaters in this province are electric. To examine the present state-of-the-art of commercially available solar water heater systems, Ontario Hydro has purchased and tested several systems. The paper describes the systems purchased, the test program, and the results. The instrumentation package including special instrumentation developed for the tests is discussed. An outline is given of a simple analytical technique which was adapted to permit accurate prediction of the annual performance of any solar water heater system on a month by month basis.

52955 Domestic water preheating using solar energy. Ireton, V.M. (Univ. of New Brunswick, Fredericton). pp 6.2.1.1-6.2.1.11 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

This paper reports upon the experience gained from the operation and monitoring of a closed loop solar energy collection system to preheat domestic water. The system has operated continuously and reliably since it was commissioned in late March 1977. Data collection began on April 1, 1977, and has continued to date. The contribution by solar energy to the preheating of the domestic water has been much less than that predicted by an f-chart analysis of the system as installed. The disagreement between experience and the f-chart model seems to be principally because of poor heat exchanger effectiveness and reverse thermal stratification in the preheat tank. It may be that drain-back or drain-down systems would be more effective than closed loop collection systems.

52956 Economic design of a solar domestic water heating system. Yuill, G.K. (UNIES Ltd., Winnipeg, Manitoba). pp 6.2.4.1-6.2.4.9 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

This paper describes the optimization of a solar domestic water heating system for a ten family townhouse in Winnipeg. The major criterion for the design of this system was that it supplied 50% of the total heat requirements of the domestic water system. So that this requirement could be met at minimum cost, a computer program was developed to model the system, and a wide range of alternatives were modelled to determine their cost effectiveness.

52957 Control system for solar hot water system. Lesperance, M.J.; Tomita, R.M.; Cadieux, S. (Atelier Solaire Eng., Pointe Claire, Quebec). pp 7.2.1.1-7.2.1.7 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

The authors evaluate the criteria of design and components selection for a solar assisted domestic hot water heating system. A practical point of view is given for the selection and installation of sensors, pumps, valves, and other control accessories. A comparison is made between an ON-OFF and proportional control system for a solar open domestic hot water system.

52958 Energy conservation for outdoor swimming pools with auxiliary solar heating. Besant, R.W.; Dumont, R.S.; Schoenau, G.J. (Univ. of Saskatchewan, Saskatoon). pp 8.2.1.1-8.2.1.11 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

This paper describes and analyzes various means to reduce heating loads for outdoor pools including pool covers and the use of low cost solar collectors. The cost of such energy conservation measures and solar collectors may be recovered in the first year of operation compared to an outdoor pool with no means of retaining solar energy gained during the day. Results are presented for the cost and operation of such a pool in Saskatoon from the summers of 1977 and 1978 where pool temperatures were maintained above 25°C throughout the summer. The capital and annual operating costs for this outdoor pool heating system were found to be $12/m^2 and $0.25/m^2, respectively.

52959 Solar heated indoor swimming pool, using air collection and distribution. Schefter, H. pp 6.1.6.1-6.1.6.2 of Renewable alternatives. Volume 2. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

A basic description of the system is given. We take the hot air from the collectors through a heat exchanger for the pool water. After the air passes through the heat exchanger it is fed into the furnace. If there is insufficient heat in the air, the furnace brings it to required temperature for the pool enclosure space. In order to maintain proper relative humidity in the pool enclosure we must exhaust air and bring in fresh air almost continually. To reduce the excessive heat loss by the exhaust air, we have installed heat reclaim coil between the fresh air intake duct and the exhaust air duct.

52960 Solar heating of domestic hot water at the Confederation Heights Cafeteria. Hampton, D.H.; Lefeuvre, T. (Public Works Canada, Ottawa, Ontario). pp 6.2.2.1-6.2.2.9 of Renewable alternatives. Volume 2. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

In 1977, Public Works Canada installed a solar energy system at the Confederation Heights Cafeteria and Fitness Centre. This project serves three purposes: (1) as an experiment, (2) as a demonstration, and (3) as a water preheater. On the basis of 144 m^2 of installed collectors, the annual solar contribution was estimated to range from 37% to 63% for domestic hot water consumption rates of 16,000 L/d and 8,000 L/d, respectively. The project was completed from identification to start up in approximately six months. This paper discusses in detail the conduct of, and lessons learned from four phases of the project: (1) rationale, objectives, and concepts; (2) detailed design of the solar system; (3) components acquisition and construction; and (4) monitoring of performance and results to date.

52961 **P.E.I. solar assisted domestic water heater project.** Brown, C.K. (Inst. of Man and Resources, Charlottetown, Prince Edward Island). pp 6.2.3.1-6.2.3.10 of Renewable alternatives. Volume 2. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

The Institute of Man and Resources is conducting a solar assisted domestic water heating demonstration project under the terms of the Canada/P.E.I. Renewable Energy Development Agreement. A total of fifteen commercially available units and units of our own design will be tested. The first six units have been operating for between four and ten months. Our experience suggests that total costs for commercial systems installed by a contractor will likely begin at about $3,500. However, by providing his own labor and expertise, a handy homeowner could install a system that would pay for itself at today's energy prices in high energy cost areas.

OTHER

REFER ALSO TO CITATION(S) 52807, 52809, 52895, 52897, 52898

52962 (LA-UR—79-1650) **Treatment of molybdenite ore with laboratory scale solar furnaces.** Coutures, J.P.; Benezech, G.; Renard, R.; Skaggs, S.R. (Los Alamos Scientific Lab., NM (USA); Laboratoire des Ultra-Refractaires, Odeillo (France)). 1979. Contract W-7405-ENG-36. 7p. (CONF-790541—28). P 02/MF A01.

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The conventional method of extracting molybdenite concentrate (MoS_2) from raw ore consumes 145 x 10^6 Btu/ton of concentrate in fossil fuel equivalent energy. Processing the ore using a solar hear source could save 56% of this energy. Thermodynamic considerations indicate that MoS_2 is the easiest of the economically valuable ores to extract using a solar heat source. Oxidation of MoS_2 to molybdic oxide (MoO_3) is an exothermic process, and it should proceed autogenically if the concentration of MoS_2 is high enough. Experiments to measure the specific heat of the raw ore were conducted to determine the crossover point for concentration of molybdenite vs sensible heat of the reaction. The reaction temperatures were measured using a calorimeter, and three distinct reaction temperatures were found. These were identified as water and organic vapors, the oxidation of pyrite (FeS_2) which is present in the raw ore, and oxidation of the molybdenite. The production rate of SO_2 was measured for 0.5 g samples of three different concentrations of molybdenite: (1) 95% MoS_2 concentrate, (2) 10% concentrate mixed with the raw ore, and (3) the unadulterated raw ore. A crude mass balance was obtained between the reacted product (oxide) and the unreacted ore (sulfide) in the hearth. The curves of reacted product vs time look very similar to the curves of SO_2 gas production as a function of time. Both sets of curves show the reaction is more than 90% complete in one minute.

52963 **Feasibility of using solar energy for lumber drying in northwestern Ontario.** Yang, K.C. (Lakehead Univ., Thunder Bay, Ontario). pp 4.1.3.1-4.1.3.18 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

A uniquely designed solar heated dry kiln with a capacity of 1.89 m^3 (800 bf) was constructed on the campus of Lakehead University to study the feasibility of using solar energy for lumber drying in Northwestern Ontario. The winter temperature differential between the inside and outside averaged 22°C (40°F) during afternoon on sunny days (1300—1700 hrs). The lumber drying rate inside the kiln was twice as fast as air drying. Lumber degrade was considerably less than in air dried lumber.

SOLAR COLLECTORS AND CONCENTRATORS

REFER ALSO TO CITATION(S) 52791, 52792, 52806, 52807, 52821, 52824, 52825, 52838, 52856, 52857, 52858, 52859, 52862, 52863, 52864, 52865, 52866, 52891, 52893, 52922

52964 (ALO—5302-T1) **Black germanium selective absorber surfaces. Semi-annual progress report, September 1, 1978-March 1, 1979.** Messier, R.F.; Vedam, K. (Pennsylvania State Univ., University Park (USA). Materials Research Labs.). 23 Apr 1979. Contract EM-78-C-04-5302. 10p. P 02/MF A01.

It was shown that by controlling the sputtering preparation conditions of noncrystalline Ge films the surface microstructure can be drastically altered by simply etching in 30% H_2O_2. The resulting surface has a total reflectance of less than 3% in the solar spectrum. This flat-black surface appearance is shown to be due to a dense array of aligned, needle-like protrusions which have an extremely high aspect ratio and both a cross-sectional area and a separation between needles on the order of the wavelength of solar radiation. A systematic series of thin films were prepared by rf-sputtering with rf-power and Ar gas pressure as the primary preparation parameters and characterizing the various films.

52965 (ANL-CT—79-34) **Stability considerations and a double-diffusive convection model for solar ponds.** Lin, E.I.H.; Sha, W.T.; Soo, S.L. (Argonne National Lab., IL (USA); Illinois Univ., Urbana (USA)). Apr 1979. Contract W-31-109-ENG-38. 42p. P 03/MF A01.

A brief survey is made on the basic principles, current designs and economic advantages of salinity-gradient solar ponds as solar collectors and reservoirs. Solar ponds are well-suited for various AIPH (agricultural and industrial process heat) applications, and as annual storage devices for space heating and cooling. The benefit of an efficient pond is demonstrated via a preliminary economic analysis which suggests the idea of energy farming as a profitable alternative for land usage in the face of rising fuel cost. The economy and reliability of solar-pond operation depend crucially on the stability of the nonconvective gradient zone against disturbances such as generated by a severe weather condition. Attention is focused on the subject of stability, and pertinent existing results are summarized and discussed. Details of the derivation of three-dimensional stability criteria for thermohaline convection with linear gradients are presented. Ten key questions pertaining to stability are posed, whose answers must be sought through extensive analytical and numerical studies. Possible methods of approach toward enhancing solar-pond stability are also discussed. For the numerical studies of pond behavior and stability characteristics, a double-diffusive convection model is proposed. The model can be constructed by extending the three-dimensional thermohydrodynamic computer code COMMIX-SA, following the necessary steps outlined; computational plans are described. Similarities exist between the halothermocline and the thermocline storage systems, and an extended COMMIX-SA will be a valuable tool for the investigation of both.

52966 (BMFT-FBT—79-06) **Technical applications of solar energy.** Arafa, A.; Ardt, W.; Bilger, G. (Stuttgart Univ. (TH) (Germany, F.R.). Inst. fuer die Technische Nutzung Solarer Energie). Jun 1979. 271p. (In German). U 12/MF A01.

Experimental and theoretical investigations are presented on the conversion and utilization of solar energy. The main subjects are: laboratory measurements and investigations with flat plate water collectors; hot water heat storage; development and measurements of selective surfaces; thermoelectric energy conversion; measurement of meteorological and radiation data and data acquisition; outdoor testing of water and air flat plate collectors; measurement of the energy balance in a solar house; photovoltaic experiments with flat and concentrating generators; system study on photovoltaic systems; hybrid flat plate collectors (thermal + photovoltaic); technology of Cu_2S—CdS-thin film solar cells (evaporated CdS-layer, formation of Cu_2S-layer contacts, encapsulation, testing etc.); study on the improvement of solar cell use by light conversion with luminescent substances; and time resolved measurement of the global radiation spectrum.

52967 (COO—2577-18) **Comparative performance of two types of evacuated tube solar collectors in a residential heating and cooling system. The progress report.** Conway, T.M.; Duff, W.S.; Lof, G.O.G.; Pratt, R.G. (Colorado State Univ., Fort Collins (USA)). 1979. Contract EY-76-S-02-2577. 5p. (CONF-790541—52). P 02/MF A01.

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Two types of evacuated tube solar collectors have been operated in space heating, cooling and domestic hot water heating systems in Colorado State University Solar House I. An experimental collector from Corning Glass Works supplied heat to the system from January 1977 through February 1978, and an experimental collector from Philips Research Laboratory, Aachen, which is currently in use, has been operating since August 1978. A flat absorber plate inside a single-walled glass tube is used in the Corning design, whereas heat is conducted through a single glass wall to an external heat exchanger plate in the Philips collector. In comparison with conventional flat-plate collectors, both types show reduced heat losses and improved efficiency. For space heating and hot water supply in winter, the solar delivery efficiency of the Corning collector ranged from 49% to 60% of the incident solar energy. The

portion of the space heating and domestic hot water load carried by solar energy through fall and winter ranged from 50% to 74%, with a four-month contribution of 61% of the total requirements. Data on the Philips collector are currently being analyzed.

52968 (COO—4878-5) **Ceramic solar receivers.** Jarvinen, P.O. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 1979. Contract ET-78-S-02-4878. 6p. (CONF-790803—39). P 02/MF A01.

From 14. intersociety energy conversion conference; Boston, MA, USA (5 Aug 1979).

The application of ceramic materials to high temperature solar receivers for advanced Brayton and advanced Stirling thermal electric systems is discussed. Conceptual designs for ceramic cavity receivers employing impingement jet-cooled, dome-shaped silicon carbide heat exchanger modules are offered. Optical, mechanical, heat transfer and structural analyses of this novel receiver approach are presented.

52969 (DOE/JPL—1024-78/1) **Fixed tilt solar collector employing reversible vee-trough reflectors and evacuated tube receivers for solar heating and cooling systems. Final report, Phase II data acquisition.** Selcuk, M.K. (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Oct 1978. Contract EX-76-A-29-1024. 96p. (JPL-PUB—78-106). P 05/MF A01.

The objective of the Vee-Trough/Evacuated Tube Collector (VTETC) Project, undertaken for the DOE Solar Heating and Cooling Branch, was to show how vee-trough concentrators could improve the heat collection capability and reduce the cost of collectors consisting of evacuated tube receivers. The work was carried out in two phases. During the first phase, the VTETC was analyzed rigorously and various mathematical models were developed to calculate the optical performance of the vee-trough concentrators and the thermal performance of the evacuated tube receivers. A test bed was constructed to verify the mathematical analyses and compare reflectors made of back-silvered glass mirror, Alzak, Aluminized Teflon, and Kinglux (an electro polished aluminum reflector). Testing was conducted and data was obtained for the months of April to August 1977. The results of the mathematical analyses, as well as the results from 1977, were reported in DOE/JPL/1024-1, published in January 1978. In the second phase, additional tests were run at temperatures ranging from 80 to 190°C (176 to 374°F) during the months of April, May, June, and July 1978. The results obtained compared well with theoretical predictions. For the glass mirror reflectors, peak efficiencies, based on aperture area and operating temperatures of 125°C (257°F), were over 40%. Efficiencies of about 40% were observed at temperatures of 150°C (302°F) and 30% at 175°C (347°F). Test data covering a complete day are presented for selected dates throughout the test season. Predicted daily useful heats collected and efficiency values are presented for a full year. These theoretical values are then compared with actual data points for the same temperature range.

52970 (DOE/NASA/CR—150523) **Long-term weathering effects on the thermal performance of the Solargenics (liquid) solar collector at outdoor conditions.** (Wyle Labs., Huntsville, AL (USA). Solar Energy Systems Div.). Jul 1979. Contract EX-76-A-29-1037. 14p. P 02/MF A01.

The test procedures used and the results obtained during the evaluation test program of the Solargenics single-covered liquid solar collector are presented. The tests were performed under outdoor natural conditions at the Solar Test Facility at MSFC, following long-term exposure to natural weathering conditions. The collector was under stagnation conditions from August 26, 1978, to June 13, 1979, for a total of approximately ten months. The Solargenics solar collector is a liquid, single-glazed, flat-plate collector, and is about 240 inches long, 38 inches wide, and 3.8 inches in depth.

52971 (DOE/NASA/CR—150794) **Indoor test and long-term weathering effects on the thermal performance of the solar energy system (liquid) solar collector.** (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). May 1979. Contract EG-77-C-01-4050;EX-76-A-29-1037. 42p. P 03/MF A01.

The procedures used and the results obtained during the evaluation test program on the Solar Energy Systems, Inc., (Liquid) Solar Collector are presented. The narrow flat-plate collector with reflective concentrating mirrors uses water as the working fluid. The double-covered collector weighs 137 pounds and has overall dimensions of about 35" x 77" x 6.75". The test program was conducted to obtain the following information: thermal performance data under simulated conditions, structural behavior under static load, and the effects of long-term exposure to natural weathering. These tests were conducted using the MSFC Solar Test Facility and Solar Simulator.

52972 (LBL—9317) **New solar thermal receiver utilizing small particles.** Hunt, A.J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1979. Contract W-7405-ENG-48. 6p. (CONF-790541—42). P 02/MF A01.

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A new type of solar thermal receiver is being developed that utilizes a dispersion of very small particles suspended in a gas to absorb concentrated sunlight. An open Brayton cycle heat engine utilizing a Small Particle Heat Exchange Receiver (SPHER) operates by injecting a very small mass of submicron carbon particles into the compressed gas stream before it enters the receiver. The particles absorb the radiation, release the heat to the surrounding gas, and are vaporized. The phase change (vaporization) stabilizes the output temperature and eliminates the particles from the gas stream before it passes into the exhaust turbine. Two receiver designs have been investigated and both have theoretical efficiencies greater than 90% at output gas temperatures of 1000°C. This design gives thermal cycle efficiencies in excess of 40%. Calculations of the optical and thermal processes have been performed and the concept has been demonstrated in the laboratory.

52973 (SAND—78-0983) **Evaluation of the evacuated solar annular receivers used at the midtemperature solar systems test facility (MSSTF).** Ratzel, A.C. (Sandia Labs., Albuquerque, NM (USA)). Jul 1979. Contract EY-76-C-04-0789. 59p. P 04/MF A01.

Experimental studies at the Sandia/DOE Midtemperature Solar Systems Test Facility (MSSTF) using the parabolic-cylindrical collector field subsystem are described. Tests evaluated vacuum integrity characteristics of ten glass-to-metal sealed concentric-cylinder receivers installed at the MSSTF in May 1977. Additional testing measured heat-loss reductions and related collector performance gains possible by annulus gas evacuation. Structural defects in four receivers and gas desorption from the receiver tubes at temperatures > 470°K necessitated continuous annulus gas evacuation. Pressure rises of 1.8×10^{-4} Pa/s and 2.2×10^{-2} Pa/s, measured with receiver tube surfaces at 443°K and 578°K, respectively, are indicative of the outgassing. One-sun heat-loss and collector efficiency tests were performed with air-filled annular spaces maintained at 8.379×10^{4} Pa (atmospheric pressure) and at pressures < 10 Pa. Overall collector efficiency improved by 3.5 to 9% and one-sun heat losses were reduced by 20 to 50%, depending upon operating temperature, annulus pressures, and insolation. Failure of the receiver assemblies to maintain annulus pressures below 1 Pa precluded expected overall efficiency improvements of 11 to 12%. Further, onsite vacuum maintenance was proved unfeasible because of the extensive pumpout manifolding and the additional manpower, parasitic energy, and capital equipment costs required.

52974 (SAND—78-2046C) **Practical method for including material scattering effects in determining the amount of intercepted sunlight in solar concentrators.** Pettit, R.B.; Vittitoe, C.N.; Biggs, F. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 5p. (CONF-790541—33). P 02/MF A01.

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

In imaging solar concentrators, the amount of solar radiation incident on a receiver surface depends upon both the overall concentrator shape and the angular distribution of light rays (sunshape) that reach the receiver. Sunshape broadening effects, which include the specular reflectance or transmittance properties of mirrors or glazings, image degradation caused by surface slope errors, and tracking errors are combined into an effective error cone. Broadened sunshapes for a variety of effective error-cone distributions are calculated and presented in graphical form. It is found that when the root-mean-square (RMS) width of the effective error cone is approximately 2 to 3 times the RMS width of the incident sunshape, the broadened sunshape can be adequately described by a circular normal distribution.

52975 (SAND—79-7023) **Analysis of field test results for single-axis-tracking solar collector foundations.** Auld, H.E. (Higgins, Auld and Associates, Albuquerque, NM (USA)). Jul 1979. Contract EY-76-C-04-0789. 38p. P 03/MF A01.

Five reinforced concrete cylindrical piers, typical of foundations utilized for single-axis-tracking solar collector systems, were tested to determine eccentric horizontal and vertical failure loads. The results from these tests were found to compare favorably with the results from theoretical calculations which incorporate the geotechnical parameters of the test site. Recommendations are made for the incorporation of these results into the design of foundations for future solar collector systems.

52976 (SERI/TP—31-061) **Proceedings: DOE/DST thermal power systems workshop on selective absorber coatings.** Call, P. (Solar Energy Research Inst., Golden, CO (USA)). Aug 1978. Contract EG-77-C-01-4042. 500p. (CONF-771230—). P 21/MF A01.

From Thermal power systems workshop on selective absorber coatings; Golden, CO, USA (6 Dec 1977).

Separate abstracts were prepared for the 22 papers presented. Structured discussions are included in the proceedings. (WHK)

52977 (SERI/TP—31-061, pp 13-50) **Development of selective absorber coatings for solar thermal power systems.** Melamed, L. Aug 1978.

From Thermal power systems workshop on selective absorber coatings; Golden, CO, USA (6 Dec 1977).

The need for spectrally selective absorbers for distributed collector power plants (300°C range) and tower focus power plants (500°C range) is discussed. The state-of-the-art of selective coatings including black chromium, black nickel, AMA coatings, and selective paints is described. Current coatings research is reviewed. Bulk semiconductor/metal stack, amorphous semiconductors, graded index semiconductors, and particulate metal-dielectric composites are discussed. 49 references. (WHK)

52978 (SERI/TP—31-061, pp 111-121) **DOE solar heating & cooling and agricultural/industrial process heat programs.** Sargent, S. (Dept. of Energy, Washington, DC); Moore, S. Aug 1978.

From Thermal power systems workshop on selective absorber coatings; Golden, CO, USA (6 Dec 1977).

DOE programs and contracts on research and development of spectrally selective surfaces are discussed. (WHK)

52979 (SERI/TP—31-061, pp 137-147) **Historical perspective: coatings for solar collectors.** Jurisson, J. (Honeywell, Inc., Minneapolis, MN). Aug 1978.

From Thermal power systems workshop on selective absorber coatings; Golden, CO, USA (6 Dec 1977).

The types of specialized coatings used in solar collection systems are reviewed. The coatings can be divided into three classes: selective absorbers, anti-reflection coated windows, and heat reflecting windows. The ideal spectral behavior for selective surfaces are discussed, including the influence of solar concentration and collection temperature. Performance of collector systems with and without these special coatings are discussed and their cost effectiveness is pointed out. The pioneering steps in the implementation of solar coatings are reviewed from the early efforts of Tabor, Hottel, Hass, and Duffie and others through some of the more novel recent approaches. The basic physical phenomena at work in achieving selectivity are reviewed. Accurate optical property measurements were a key factor in the early development of selective surfaces.

52980 (SERI/TP—31-061, pp 149-151) **Optical measurements of selective solar absorber coatings.** Richmond, J.C. (National Bureau of Standards, Washington, DC). Aug 1978.

From Thermal power systems workshop on selective absorber coatings; Golden, CO, USA (6 Dec 1977).

The efficiency of a solar collector may be defined as the fraction of the solar energy incident upon it that is transferred as heat to the heat transfer fluid. Losses from the collector fall into three categories: (1) incident solar flux that is reflected from the collector; (2) heat loss from the collector by reradiation to the surroundings; and (3) heat lost from the collector by convection and conduction. Ways of evaluating heat losses by the first two of these categories are discussed.

52981 (SERI/TP—31-061, pp 153-163) **Evaluation of solar absorptance.** Richmond, J.C. (National Bureau of Standards, Washington, DC). Aug 1978.

From Thermal power systems workshop on selective absorber coatings; Golden, CO, USA (6 Dec 1977).

A major source of the differences in values of solar absorptance for supposedly identical materials reported by laboratories working on contracts for the Division of Solar Power of the Department of Energy appears to be the method used to convert spectral reflectance data to solar absorptance. Computation procedures are discussed, and recommendations made for standardization.

52982 (SERI/TP—31-061, pp 165-166) **Surface film analysis and profiling techniques.** Wehner, G.K. (Univ. of Minnesota, Minneapolis). Aug 1978.

From Thermal power systems workshop on selective absorber coatings; Golden, CO, USA (6 Dec 1977).

Research on various analyses of coatings and films on stainless steels for use as solar absorbers is summarized. (WHK)

52983 (SERI/TP—31-061, pp 167-182) **Absorber surfaces for high temperature alloys.** Masterson, K.D. (Univ. of Arizona, Tucson). Aug 1978.

From Thermal power systems workshop on selective absorber coatings; Golden, CO, USA (6 Dec 1977).

High temperature alloys are required for the absorber materials in large central receiver solar-thermal conversion systems. The optical properties of absorber surfaces prepared on samples of alloys that are candidate receiver materials were measured. These include alloys of the Croloy, Inconel, Incoloy and stainless steel types. The absorbers consisted of native oxides grown in air in laboratory furnaces at temperatures of 500, 800, and 1000°C for times of 18 hours, 2 hours, 30 minutes respectively and a commercially available high temperature paint (Pyromark). Prior to oxidation the samples were either left as received or ground and optically polished in order to remove scale acquired during milling and to obtain optical specularity. Samples painted with Pyromark were sandblasted and then coated following the manufacturer's recommended procedure. Results are reported.

52984 (SERI/TP—31-061, pp 183-196) **Thermal aging of electrodeposited black chrome.** Sowell, R.R.; Pettit, R.B. (Sandia Labs, Albuquerque, NM). Aug 1978.

From Thermal power systems workshop on selective absorber coatings; Golden, CO, USA (6 Dec 1977).

The stability of electrodeposited black chrome coatings on the solar absorber tubes of parabolic trough receivers in Sandia's Solar Total Energy Test Facility was studied. All coatings were stable at 250°C, but the solar absorptance of some coatings decreased at 300 and 350°C. Samples were examined and analyzed, but results did not reveal an explaination of the difference between stable and unstable black chrome coatings. (WHK)

52985 (SERI/TP—31-061, pp 197-204) **Black chrome surface morphology.** Ignatiev, A. (Univ. of Houston, TX). Aug 1978.

From Thermal power systems workshop on selective absorber coatings; Golden, CO, USA (6 Dec 1977).

The surface morphology or microstructure of electro-deposited black chrome and inert-gas chrome have been studied within a mean field or continuum model. The particles are assumed to have varying spheroidal shapes, e.g., various semimajor-to-semiminor-axis ratios with the distribution of these shapes being a significant factor determining the optical absorption of the blacks. This spheroidal-particle distribution can be extracted for a given black by comparing the experimentally determined absorption coefficient to that predicted by the Spheroid Model. For inert-gas chrome black, specimens were prepared by evaporation of pure chromium from a tungsten-filament-heated carbon crucible in an atmosphere of 2 torr helium. The black was deposited on glass-cover slip substrates, and integrated spectral transmittance measurements were made for wavelengths between 0.35 μ and 2.40 μ, using an integrating sphere spectrophotometer. This determined the absorption coefficient of the black, and comparison with the spheroid model yielded a log-normal distribution of spheroidal particles. A significant point that can be drawn from the Spheriod Model applies to the tailoring of the microstructure of an absorber to achieve selectivity and increased solar absorptance.

52986 (SERI/TP—31-061, pp 205-247) **Low temperature solar coatings.** Lin, R.J.H. (Honeywell, Inc., Minneapolis, MN). Aug 1978.

From Thermal power systems workshop on selective absorber coatings; Golden, CO, USA (6 Dec 1977).

Research at Honeywell on various coatings for improving solar collector efficiency is described. Coatings investigated include selective absorbing plated and paint coatings and antireflection coatings for window materials. Some results are given. (WHK)

52987 (SERI/TP—31-061, pp 249-287) **High temperature spectrally selective coatings fabricated by chemical vapor deposition.** Seraphin, B.O. (Univ. of Arizona, Tucson). Aug 1978.

From Thermal power systems workshop on selective absorber coatings; Golden, CO, USA (6 Dec 1977).

A chemical vapor deposition procedure for fabricating multilayer stacks of semiconductor materials and stabilizing films for spectral selectivity is described. The procedure can be readily expanded for large-scale manufacturing of high-temperature solar absorbers. Procedures, results, and plans are described. (WHK)

52988 (SERI/TP—31-061, pp 289-304) **Amorphous semiconductor thin films in solar thermal conversion.** Griffith, R.W. (Brookhaven National Lab., Upton, NY). Aug 1978.

From Thermal power systems workshop on selective absorber coatings; Golden, CO, USA (6 Dec 1977).

An initial technical feasibility study on the possible use of amorphous silicon (a-Si) thin films, and those of related materials, as the basis of the primary absorber in a selective absorber coating is described. The study consisted of a theoretical investigation, and a modest experimental component to probe and test areas of especial interest. Findings are reported.

52989 (SERI/TP—31-061, pp 305-315) **Composite dielectrics.** Gittleman, J.I. (RCA Labs., Princeton, NJ). Aug 1978.

From Thermal power systems workshop on selective absorber coatings; Golden, CO, USA (6 Dec 1977).

A program to study the utility of dispersions of Si and Ge in transparent insulators as selective absorbers for the photothermal conversion of solar energy is described. Si and Ge are nearly ideal selective absorbers for high temperature, low concentration factor photothermal conversion. Because of the well defined energy gap, they exhibit high absorbtance in the visible and low emittance in the infrared and a very sharp transition from one behavior to the other. However, their high index of refraction results in a large fraction of solar radiation being reflected rather than absorbed. Co-sputtering of

Si (or Ge) with a transparent, low index of refraction insulator produces a fine dispersion of Si grains in a transparent matrix. The optical properties of such a composite is similar to that of a semiconductor with an energy gap the same as that of Si (with a somewhat reduced extinction coefficient) but with a lower index of refraction. Thus a single sputterng process results in a film which exhibits an appreciably smaller reflection loss than pure Si and hence eliminates the need for additional processing required by the application of antireflection coatings. Work is centered on determining the optimum concentration of Si, Ge and Si-Ge alloy in CaF_2 by determining the variation of index of refraction and extinction coefficient as a function of composition and wavelength. Some results are given.

52990 (SERI/TP—31-061, pp 317-325) **Optical properties of metallic surfaces, small particles and composite coatings for solar energy conversion applications.** Ashcroft, N.; Aurbach, R.; Buhrman, R. (Cornell Univ., Ithaca, NY). Aug 1978.

From Thermal power systems workshop on selective absorber coatings; Golden, CO, USA (6 Dec 1977).

Status of a theoretical and experimental investigation of the optical and physical properties of metals, alloys, and composite coatings is outlined. (WHK)

52991 (SERI/TP—31-061, pp 335-358) **High temperature absorber paints.** Muenker, A.H. (Exxon Research and Engineering Co., Linden, NJ). Aug 1978.

From Thermal power systems workshop on selective absorber coatings; Golden, CO, USA (6 Dec 1977).

A 10 month program to develop low cost, high solar absorptive paints to accelerate solar-thermal electricity technology was initiated on July 15, 1977. Analysis of the energy balance (i.e., absorbed solar energy vs. reradiation loses) shows that for a Central Receiver operating at or above 500°C and concentration ratios of 500X to 2000X, maximizing the solar absorptance of the receiver coating is more beneficial from a standpoint of net energy gain than minimizing IR emissivity. System studies consistently demonstrate that the heliostat field represents about one half of projected solar power plant capital costs and that system performance directly relates to receiver absorptivity. In general, as the concentration ratio increases, system efficiency becomes less dependent on emissivity. The objective of this program is to develop a stable high temperature solar absorber paint with $\alpha \geq 0.95$ that can be applied by conventional paint spraying techniques. By sacrificing low emissivity and emphasizing maximum absorptance, the development of low cost, high temperature stable inorganic solar absorber paints becomes a realistic goal. Eliminating the criterion of selectivity, i.e., abandoning the requirement of low ϵ while maintaining the criterion of high α, also obviates the need for close control of thin film thickness, since the success of selectivity is always intimately tied to maintaining very thin coating thickness. Status of the program is described.

52992 (SERI/TP—31-061, pp 359-370) **Thin film absorber coatings from metallo-organic solutions.** Dickson, J. (Engelhard Minerals and Chemicals Corp., Edison, NJ). Aug 1978.

From Thermal power systems workshop on selective absorber coatings; Golden, CO, USA (6 Dec 1977).

This program explores the development of selectively absorbing films for the thermal conversion of solar energy at high temperatures prepared by the thermal decomposition of metallo-organic solutions. Initially the concept was directed toward films for power tower boiler uses at greater than 500°C. The program was based upon gold matrix films with 0.5 α/sub s/ developed in 1962-63 by Engelhard Industries for use in space. The data for the first sixteen months of this two year program are presented. All films were prepared from metallo-organic compounds dissolved in suitable solvents after application by painting on surface of glass, quartz and metallic substrates, and air firing at 500 to 800°C. The films thus produced are 1000 to 2000 A thick and consist of unique metal oxide systems. The compositions of the films are controlled by regulating the solution chemistry and composition. The methods for characterizing these films are briefly described, including optical measurements, high temperature emittance measurements and scanning electron microscopy. Results are presented graphically.

52993 (SERI/TP—31-061, pp 371-380) **Metal oxycarbonitride solar absorbers.** Blickensderfer, R. (Bureau of Mines, Albany, OR). Aug 1978.

From Thermal power systems workshop on selective absorber coatings; Golden, CO, USA (6 Dec 1977).

A family of carbides, oxides, and nitrides of certain Group IV metals has been found to possess a high degree of spectral selectivity in the wavelength range of interest of solar absorbers. The compounds are of the general formula MC/sub x/O/sub y/N/sub z/ where M is titanium, zirconium, or hafnium, and $x + y + z$ is less than 2. Thin films of the oxycarbonitrides of these elements were found absorptive in the solar spectrum while being very transparent in the longwave thermal spectrum. A reflective base, such as silver or aluminum, used beneath the absorptive film, controlled the longwave emittance of the substrate. The selectivity transition occurs, as in the usual thin film absorber, near the wavelength corresponding to the first interference minima of the transparent film. A high extinction coefficient in the shortwave spectrum suppresses the shortwave interference maxima.

52994 (SERI/TP—31-061, pp 409-435) **Methodology for assessing the benefits of absorber coatings for solar/thermal receivers.** Adams, M.A.; Carroll, W.F.; Reeve, R.T.; Zeldin, B. (Jet Propulsion Lab., Pasadena, CA). Aug 1978.

From Thermal power systems workshop on selective absorber coatings; Golden, CO, USA (6 Dec 1977).

The development of economically feasible solar thermal power systems requires the improvement of existing technology and breakthroughs in new technical areas. A cost effective program which will lead to viable solar power systems must emphasize those technologies critical to the successful implementation of the system design concepts. The first step in the development of a tool for evaluating the relevance and potential benefit of absorber coatings R & D is presented. Using greatly simplified assumptions, this analysis technique has been exercised to identify the potential benefits of improved coatings. By plotting isobenefit curves for the improved coatings on coordinates of incident flux vs absorber surface temperature, the potential improvement in performance may be assessed for any candidate system. A more specific definition of the benefits of particular coatings coupled with the projected costs and risk analyses of candidate systems which might employ such coatings can then be used as the basis of a cost/benefit analysis of proposed coating development work. This cost/risk/benefit analysis can be used in conjunction with similar analyses of other system elements or technologies to determine an appropriate level of R & D for coatings development. Also, the technical analysis of absorber coating effectiveness in the various operating ranges of candidate systems will identify the areas of highest return for coatings development programs and identify where these programs might, at present, be deficient or irrelevant.

52995 (SERI/TP—34-048) **Proceedings of the solar thermal concentrating collector technology symposium.** Gupta, B.P.; Kreith, F. (eds.). (Solar Energy Research Inst., Golden, CO (USA)). Aug 1978. Contract EG-77-C-01-4042. 396p. (CONF-780663—). P 17/MF A01.

From SERI concentrator symposium; Denver, CO, USA (13 Jun 1978).

The purpose of the symposium was to review the current status of the concentrating collector technology, to disseminate the information gained from experience in operating solar systems, and to highlight the significant areas of technology development that must be vigorously pursued to foster early commercialization of concentrating solar collectors. Separate abstracts were prepared for thirteen invited papers and working group summaries. Two papers were previously abstracted for EDB.

52996 (SERI/TP—34-048, pp 1-42) **Optical and thermal analysis of concentrators.** Rabl, A. (Solar Energy Research Inst., Golden, CO). Aug 1978.

From SERI concentrator symposium; Denver, CO, USA (13 Jun 1978).

The general relation between concentration ratio and acceptance angle is discussed and illustrated with examples for typical designs of solar concentrators. To a good approximation a collector of concentration C accepts 1/C of the diffuse solar radiation. Special optical properties of linear concentrators are addressed. A simple method is presented for analyzing the optics of glass tubes. A general framework for analyzing the efficiency of thermal collectors is discussed. Conversion factors are given for converting the efficiency from one base to another. The relationship between instantaneous efficiency and long-term average energy delivery is discussed, and use of the long-term average optical efficiency is recommended as a simple means of incorporating incidence angle effects. A discussion of a particular class of concentrators, the CPC (= compound parabolic concentrator), is given. Performance data for solar collectors with CPC reflectors and evacuated receiver tubes is presented. Operating efficiencies above 40% at 150°C have been demonstrated with fixed CPC collectors (concentration $C = 1.5$) and off-the-shelf components (receiver tubes supplied by General Electric and by Owens—Illinois).

52997 (SERI/TP—34-048, pp 73-120) **Parabolic concentrating collector.** Truscello, V.C. (Jet Propulsion Lab., Pasadena, CA). Aug 1978.

From SERI concentrator symposium; Denver, CO, USA (13 Jun 1978).

A tutorial overview of point-focusing parabolic collectors is presented. In the first section, the optical and thermal characteristics of such collectors are discussed in some detail. Data representing typical achievable collector efficiencies are presented, and the importance of balancing collector cost with concentrator quality is argued through the development of a figure of merit for the collector. The impact of receiver temperature on performance is assessed

and the general observation made that temperatures much in excess of 1500 to 2000°F can actually result in decreased performance. In the second section, various types of two-axis tracking collectors are described, including the standard parabolic deep dish, Cassegrainian and Fresnel, as well as two forms of fixed mirror collectors with articulating receivers. In the third section, the present DOE program to develop these devices is briefly discussed. Finally, the last section discusses present and projected costs of these collectors. Pricing information is presented for the only known (to the author) commercial design available on the open market.

52998 (SERI/TP—34-048, pp 225-280) **International developments in concentrators.** Walton, J.D. Jr. (Georgia Inst. of Tech., Atlanta). Aug 1978.

From SERI concentrator symposium; Denver, CO, USA (13 Jun 1978).

The principal characteristics of the five large solar furnace (over 10 kWt) built and operated during the past 25 years in France, Algeria, and Japan for high temperature research and development are described. These are of two basic types: (1) direct solar concentration using a paraboloid concentrator; and (2) redirection of solar radiation from one or more heliostats to a paraboloid or spherical concentrator. The major solar thermal conversion systems which were built and demonstrated during the past 15 years are reviewed. These include the DOE Advanced Component Test Faility at Georgia Tech and experimental efforts in Japan and France. The use of the CNRS 1000 kWt solar furnace to evaluate the Martin Marietta cavity type receiver for steam generation and the CNRS oil cooled receiver for producing electric power through a steam turbine is described. The current national and international programs for solar thermal power generation and concentrating collector activities in less developed countries are summarized. (LBS)

52999 (SERI/TP—34-048, pp 281-294) **Absorber surfaces and reflective materials.** Call, P.; Masterson, K. (Solar Energy Research Inst., Golden, CO). Aug 1978.

From SERI concentrator symposium; Denver, CO, USA (13 Jun 1978).

Discussion summaries of the working groups on absorber surfaces and reflective materials are presented. The group on absorber surfaces discussed three issues: (1) commercial absorber surfaces for concentrating collectors; (2) degradation mechanisms of black chrome; and (3) durability and lifetime testing for absorber surfaces. Two general areas of concern for reflective materials were addressed, namely reflector specularity and life testing degradation.

53000 (SERI/TP—34-048, pp 295-302) **Mechanical-structural analysis and design considerations.** Frohardt, M.W. (Martin Marietta Aerospace Div., Denver, CO). Aug 1978.

From SERI concentrator symposium; Denver, CO, USA (13 Jun 1978).

The technological barriers that exist in concentrating collector technology were discussed and areas needing basic and applied research were identified. A brief review of concentrating collector technology applicable to solar heating and cooling, process heat, electrical generation and photovoltaics is given. Among the problem areas identified were windloading, hail effects, curved collector fabrication methods, seals, gaskets and equipment design support.

53001 (SERI/TP—34-048, pp 311-328) **Performance standards development for concentrating collectors.** Wood, B.D. (Arizona State Univ., Tempe). Aug 1978.

From SERI concentrator symposium; Denver, CO, USA (13 Jun 1978).

A summary of the workshop to determine the status of performance standards for concentrating collectors is presented. A brief discussion is given on the ASHRAE Standard 93-77 for determining the thermal performance of solar collectors. This standard includes three tests: (1) collector time constant test; (2) near normal incidence efficiency test; and (3) incident angle modifier test. Recommendations for a concensus standard for testing concentrating collectors are presented. (LBS)

53002 (SERI/TP—34-048, pp 329-338) **Controls for concentrating collector systems.** Tobias, J. (Honeywell, Inc., Minneapolis, MN). Aug 1978.

From SERI concentrator symposium; Denver, CO, USA (13 Jun 1978).

Summaries of the workshop discussions on tracking control, drive control, safety control and system controls for concentrating solar collectors are presented. Tracking control was concluded to be the most prevalent problem for concentrating collectors, although systems control engineering was also sometimes lacking.

53003 (SERI/TP—34-048, pp 339-348) **Cleaning and maintenance.** Champion, R.L. (Sandia Labs., Albuquerque, NM). Aug 1978.

From SERI concentrator symposium; Denver, CO, USA (13 Jun 1978).

The cleaning of collectors was considered. Cleaning of reflector (or refractor) surfaces, or the transparent envelope surrounding the receiver tube, is necessary to prevent a decrease in specular reflectance and performance. Contaminants which accumulate on collectors are typically airborne local soil and dust particles. Further investigtion of the adhesion mechanism between the collector surface and foreign particles is required. The problems of the mechanics of washing reflector surfaces are discussed and methods for decreasing the rate of dirt accumulation are mentioned.

53004 (SERI/TP—34-048, pp 349-358) **High temperature receiver materials performance.** Clements, L.D. (Texas Tech Univ., Lubbock). Aug 1978.

From SERI concentrator symposium; Denver, CO, USA (13 Jun 1978).

This report considers the performance of several materials as components of high temperature solar receivers. A high temperature receiver was defined on the basis of materials capabilities. Ceramics, metals, and special coatings were discussed as possible receiver materials.

53005 (SERI/TP—34-048, pp 359-370) **Collector production and manufacturing.** Feasby, D. (Solar Energy Research Inst., Golden, CO). Aug 1978.

From SERI concentrator symposium; Denver, CO, USA (13 Jun 1978).

A discussion of topics relevant to the production and manufacturing of concentrating collectors is presented. Government action to assist the concentrating collector industry in reducing collector costs, through incentives to the industry itself or direct incentives to consumers to procure concentrating collector systems, would have a positive effect in the near term. Various types of government involvement, to aid in early market penetration were discussed.

53006 (SERI/TP—34-048, pp 371-378) **Line focus receiver technology.** Gerwin, H. (Sandia Labs., Albuquerque, NM). Aug 1978.

From SERI concentrator symposium; Denver, CO, USA (13 Jun 1978).

Several aspects in the design and application of line focus receivers are discussed. For photovoltaic applications, line focus collectors provide uniformity of concentrated flux resulting in improved cell output. The effects of absorber and receiver sagging (shift in receiver focus line), glass envelopes to reduce convective conductance losses, and the use of heat pipes are discussed. Water versus oil as a transfer fluid is compared. A brief discussion of low rim angle reflectors and flux mapping of linear receivers is presented.

53007 (SERI/TP—34-115) **Heat transfer and receiver R & D.** Benham, C.; Gupta, B.; Kreith, F. (Solar Energy Research Inst., Golden, CO (USA)). Jan 1979. Contract EG-77-C-01-4042. 9p. P 02/MF A01.

The task emphasizes three areas, namely, laboratory-scale tests on receiver and transport concepts, advanced receiver conceptual design, and field tests using paraboloid concentrators. The task focuses on receiver and transport systems for applications other than electrical power generation, such as industrial process heat and production of fuels and chemicals. The R & D plans are briefly discussed.

53008 (SERI/TP—35-277) **Salt concentration gradient solar ponds: modeling and optimization.** Jayadev, T.S.; Henderson, J. (Solar Energy Research Inst., Golden, CO (USA)). 1979. Contract EG-77-C-01-4042. 6p. (CONF-790541—14). Dep. NTIS, PC A02/MF A01.

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A computer simulation design tool has been developed to simulate dynamic thermal performance for salinity gradient solar ponds. This program will be available to the public through the SERI Solar Analysis Methods Center. Dynamic programming techniques are applied to allow significant user flexibility in analyzing pond performance under realistic load and weather conditions. Finite element techniques describe conduction heat transfer through the pond, earth, and edges. Results are presented that illustrate typical thermal performance of salinity gradient ponds. Sensitivity studies of salty pond thermal performance with respect to geometry, load, and optical transmission are included.

53009 **Solar energy collection system.** Nicolaisen, B.H. (to Olin Corp.). US Patent 4,161,170. 17 Jul 1979. Filed date 17 Nov 1977. 6p.

A solar energy collection system is disclosed which employs an asymmetric gas such as ammonia in an enclosed gas space between a black-coated solar energy absorber plate and the ambient atmosphere is described. The asymmetric gas allows solar radiation to be transmitted to the absorber plate where the radiation is converted into thermal energy. However, the asymmetric gas pre-

vents re-radiation of infrared thermal radiation into the ambient atmosphere.

53010 Focussing flat plate solar collector device. Brussels, N.E.; Piasecki, E.S. (to Solar Energy Systems, Inc.). US Patent 4,161,169. 17 Jul 1979. Filed date 14 Jul 1977. 12p.

A solar collector is disclosed that enables the installation of the collector parallel to the surface plane or angle of any structure, including vertical walls and flat roofs, without affecting generating efficiency. The collector is efficient for both energy absorption and transfer to the transport fluid. The collector removes architectural constraints and is suitable for building structure applications not heretofore possible. The collector comprises an array of integral fin/tube extrusions all of which are aligned in the East-West direction. Mechanical linkage rotates the extrusions in unison, with a sun tracking device, to the solar altitude angle. The extrusions, mechanical linkage, and sun tracking device are contained within an insulated housing enclosure. The integral fluid channels likewise extend in an East-West direction, are spaced apart in the North-South direction and are directed to supply and return manifold piping extending in the North-South direction with inlet and outlet connections. The extrusions have a black anodized selective coating for high absorptance and low emittance. The housing enclosure has a glazing cover.

53011 Self-powered tracking solar collector. Wininger, D.V. US Patent 4,158,356. 19 Jun 1979. Filed date 22 Feb 1977. 14p.

A solar collector is disclosed tracking the sun through changes in the relative position between the sun and the earth. The collector may rotate about a single axis to follow the sun throughout the day. A second optional axis may compensate for the orientations of the sun in different seasons of the year. The energy received by the collector provides the motive power to effect its positional changes. A reflective concave surface with cylinderal symmetry and a cross-sectional parabolic configuration provides concentrate solar radiation at a transducer. Furnaces with an expandable fluid on either side of the focal line of the parabola connect to pistons to orient the collector. The parabola subtends an arc of about 41° on either side of its center and, for an overall width of w, represents the locus of points equidistant between a straight line and a circle, tangent to the line, of radius $r = kw/2$. The constant k has a value dependent upon the intended latitude of the collector; varies between 0.611 and 0.825; and approximates 0.7425 for 44° of latitude. The axis of rotation passes through the collector's center of area to minimize wind effects.

53012 Solar heat collector. Gunderson, C.F. US Patent 4,156,420. 29 May 1979. Filed date 13 Jul 1977. 10p.

A solar heat collector uses elongated, tubular, outer casings, in a fixed position with respect to the solar orbit, surrounding inner tubular sections, carrying heat-conductive fluid. The outer casings are highly transparent and the walls of the outer casings are of substantial thickness and of a high refractive index to admit solar heat energy and to focus it on or towards the inner tubular sections or tubes that are of highly conductive material and have dark, heat-absorbing surfaces. One of the sides of the outer casings faces toward the sun. The other of the sides of the outer casings are coated with a highly reflective material to reflect any solar heat energy that bypasses the tubes, back to the inner tubes. Each of the casings is mounted in a substantially vertical plane, and the solar heat collector would normally consist of a plurality of such casings, or units, mounted side by side in a fixed plane approximately normal to the noonday, winter sun, or perpendicular to the sun's orbit. The upper and lower ends of the tubes are connected to a system for storing or using the heat-conductive fluid after it is warmed by the solar energy.

53013 Tracking system for solar energy collection. Nelson, D.H. (to American Solar). US Patent 4,154,221. 15 May 1979. Filed date 21 Apr 1977. 12p.

A tracking system is provided for positioning solar energy collection units to face the sun during daylight hours. The collectors are mounted generally in north-south alignment with rotatable connections to a supporting base. The connections are laterally offset from the center of gravity of the collector. Thus, the weight of the collector ends to rotate the collector about the connection points to bring the center of gravity to the lowest possible point, thereby orienting the collector generally to face the western horizon. A rotation restraint mechanism is provided to prevent the uncontrolled rotation of the collector to a degree coordinated with rotation of the earth relative to the sun, thereby positioning the collector to directly face the sun during daylight hours. A rank of collectors in parallel alignment can be connected for tandem rotation under the control of a single rotation restraining mechanism. Rotation restraint can be effectuated by means of an electric brake or by a solenoid actuated pawl and ratchet gear.

53014 Prismatic solar reflector apparatus and method of solar tracking. Gupta, P.G.; O'Neill, M.J. (to E-Systems, Inc.). US Patent 4,154,219. 15 May 1979. Filed date 11 Mar 1977. 16p.

A prismatic plate is mounted with its flat face exposed to the sun on a reflector panel for use in a solar energy collection system. The plate includes a plurality of triangular prisms with parallel longitudinal axes shaped to provide total internal reflection of incident light rays. Each prism has a cross section forming a right-angled isosceles triangle with the two equal-length, rear faces of the prism oriented at 45 degrees relative to the front face of the plate. The base of each prism forms or is parallel to a front plate surface which receives incident solar light rays. The rays are transmitted through the plate cross section without refraction in the plane of the cross section to be reflected from the two rear faces and back out the front face toward a solar receiver. The prism material has an index of refraction equal to or greater than the square root of two so that there is total internal reflection from the prism faces. The prismatic plate is mounted on a movable heliostat panel controlled by a tracking system to reflect to a solar receiver. The panel has a fixed axis directed toward a central receiver and a moving axis orthogonal to the fixed axis. The prismatic plate is mounted on the panel with the longitudinal axes of the prisms perpendicular to the moving axis. Tracking is accomplished by adjusting the panel orientation so that the plane of incidence of the incident solar rays is parallel to the longitudinal axes of the prisms and also so that the reflected solar rays intercept the receiver.

53015 Solar energy converter. Hinterberger, H. US Patent 4,153,955. 15 May 1979. Filed date 10 Mar 1977. 6p.

There is described a solar energy converter employing a stationary mirror which reflects and focuses solar radiation onto a bank of contiguous radiation concentrators through which a liquid is selectively passed as the focussed radiation passes thereacross as the elevation of the sun changes during the day.

53016 Modular construction for solar heat collector. Loef, G.O.G. US Patent 4,154,223. 15 May 1979. Filed date 6 Feb 1978. 6p.

An open top housing member, the top being arranged to be closed by a solar radiation transparent covering, is arranged to be mounted in side by side and end to end relationship with similar members to provide a large area solar heat absorber unit, and each housing member includes passageways for the flow of fluids, such as air, and means for joining the members at the passageways, thereby providing an inlet fluid manifold at one edge of the combined housings and an outlet fluid manifold at the opposite edge of the housings providing the transfer of heat absorbed by the unit to the transfer fluid. Generally, the housing members are made of lightweight sheet metal and may be secured together either by crimping edges and flanges of adjoining members or lateral mechanical pressure at the passageways, and each is provided with an adjustable gate member for varying the flow pattern of the fluid through each individual member.

53017 Solar collector for gas heating. Yu, Y.N. (to Ying Mfg., Corp.). US Patent 4,154,222. 15 May 1979. Filed date 15 Sep 1977. 6p.

The heat transfer structure comprises: (a) sandwich assembly including a heat transfer plate to receive infra-red radiation or to transmit such radiation, respectively to or from skyward, (b) the assembly defining an enclosed gas flow chamber at the underside of said plate, there being spaced air inlet and outlet ports respectively to and from the chamber, and (c) baffling in said chamber to direct gas passing through the chamber via said ports to freely flow tortuously and with turbulence adjacent major extent of the underside of said plate.

53018 Solar energy collector. Grauleau, D.; Mourier, J.; Shroff, A.; Villain, J. (to Thomson—Brandt; Compagnie des Lampes). US Patent 4,153,041. 8 May 1979. Priority date 30 Apr 1976, France, 6p.

A device is disclosed for collecting solar energy and conveying it to a zone to be heated. it comprises a tube in two parts, the first part (evaporator) being surrounded by a vaccuum and being covered with a heat absorbing material and exposed to the solar radiation. The tube contains a fluid which vaporized in the first part and absorbs heat and condenses in the second part and gives up the previously-stored heat. Th fluid in the liquid phase is returned to the first part by a capillary system.

53019 Solar collector. Tragert, W.E. (to National Patent Development Corp.). US Patent 4,153,042. 8 May 1979. Filed date 7 Oct 1977. 6p.

A solar collector is disclosed comprised of a frame and a plurality of tubular collector elements. Each collector element is comprised of an outer transparent tube, a metallic absorber tube, and an intermediate transparent tube which encloses the absorber tube. The absorber tube is coated with an absorptive coating and the outer tube is coated over a significant portion of its circumference with a reflective coating to reflect solar radiation onto the absorber tube. The intermediate tube serves to reduce convective and conductive heat losses, provides a structural support for the absorber tube, and

chemically isolates the coated absorber tube from the reflective coating on the outer tube.

53020 Solar energy collector and concentrator. Sisson, K.J. US Patent 4,150,663. 24 Apr 1979. Filed date 11 Aug 1977. 12p.

An apparatus is disclosed for concentrating solar energy upon the surface of a collector containing a circulating heat transfer medium, whereby the radiant energy may be absorbed and utilized. The apparatus includes a housing supporting a hemispherical reflector for gathering incident solar radiation and directing the reflected energy upon an arcuate fluid-bearing tubular conduit, which is adjustable seasonally for optimizing collection of solar rays. The geometry of the combination is so arranged that the reflected energy traverses the collector in response to the angle of solar rays falling on the concentrator without need for diurnal tracking.

53021 Layout for collecting solar energy applicable to acclimatizing all types of buildings. Callegari, M.S.T.; Longetto, A.A.T. US Patent 4,150,661. 24 Apr 1979. Priority date 11 Feb 1977, Spain, 6p.

A layout for collecting solar energy is described which is made up of modules formed by two or more hollow plates of variable-cross section, placed parallel to each other, in the interior of which a fluid having chemical properties which assist the collection of solar energy flows. The plates are inserted in the mouths of two collectors to which the supply and distribution ducts of the fluid are applied. The collectors have a configuration providing an area or chamber of air separating both plates, and in the opposite side, they have an upper fin, with a U cross-section, to fit into the structure of the building, and a lower flange which bears a block made of insulating material placed under the second plate.

53022 Hemispherical collector of direct dispersed and reflected waves. Sherman, B.F. Jr. US Patent 4,148,298. 10 Apr 1979. Filed date 14 Jun 1978. 12p.

A collector of waves is disclosed, such as of solar radiations entering from any direction, concentrates them upon a receiver that converts them to useful purposes. Moderate concentration factors are achieved without the necessity of tracking the sun. The reflective surface of the collector is a semicircular arc developed by rotation about an axis either in the plane of the arc passing through the center of curvature to form a hemisphere, or in the plane of the arc and tangent to one end to form a hemitoroid with a central cusp, or about some other axis; or some combination of these shapes. The device is compounded to provide an increased concentration factor. Means are taught for adapting the device to heat-collecting plates, heat pipes, or photovoltaic conversion devices (solar cells) of either disc, ribbon, or tube construction and for installing the device on surfaces of buildings with or without the capability of tracking the sun.

53023 Solar energy collector. Knight, J.R. US Patent 4,147,561. 3 Apr 1979. Priority date 25 Sep 1975, United Kingdom of Great Britain and Northern Ireland (UK), 6p.

This invention provides a solar energy collector including a Fresnel lens substantially fixed in orientation and position relative to the Earth, a receiver situated at a focal point of the said Fresnel lens, a mounting mechanism which constrains the receiver to move along the focal surface of the Fresnel lens, and orientation means for continually orientating the receiver so that the said receiver remains in a region of high intensity of radiation during periods of direct sunlight. The solar energy collector according to the invention is particularly suitable for inclusion in building structures.

53024 Apparatus for refracting, concentrating and collecting solar radiation. Blanton, C.K. US Patent 4,144,873. 20 Mar 1979. Filed date 21 Jun 1976. 4p.

A solar energy collection device includes an oblong pedestal with a heat absorbing hollow cylinder carried upon the pinnacle of the pedestal through which a heat absorbing fluid is moved. A transparent, generally cylindrical member is carried by the pedestal and encircles at least a portion of the cylinder for concentrating and transferring radiant energy incident to the periphery of the member to the heat absorbing cylinder, and thence to the fluid passing therethrough.

53025 Solar energy conversion system. Jarvinen, P. (to Sanders Associates, Inc.). US Patent 4,135,489. 23 Jan 1979. Filed date 11 Sep 1975. 18p.

A solar energy conversion system is provided which includes a black body receiver for transferring energy from focused solar radiation to a circulating gas. The receiver includes a honeycomb heat exchanger located within a chamber sealed with impingement cooled windows, the outermost one of which acts as a one way trap or diode to prevent energy radiated by the heated honeycomb from escaping to the atmosphere. The heat exchanger is formed with a number of tubes which are oriented to be illuminated end on for minimizing retroreflection of the incoming energy. Because of the end on orientation, a large majority of the incoming energy impinges on the internal walls of the tubes and is internally reflected until it is absorbed. Cool gas, which may be air, is introduced into the receiver under pressure such that the gas passes through the tubes of the heat exchanger where it is heated to temperatures that are typically in the vicinity of 1700°F. The heated gas is then extracted from the receiver downstream of the tubes.

53026 Ranking and evaluation of flat-plate collectors: two new approaches. White, J.H. (DSMA ATCON LTD., Toronto, Ontario). pp 1.1.1.1-1.1.1.12 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

Two new tools have been developed to allow ranking and evaluation of flat-plate solar collectors used in seasonal-storage solar-heating systems. The collector Ranking Index is a function of the two intercepts of the equivalent-straight-line collector efficiency equation and provides very good correlation between the heat delivered by the collector and its efficiency curve intercepts. It is independent of the system configuration used, but does vary with location. The Theory of Equivalent Reflections, the second of these tools, presents the optical performance of a collector in terms of the number of Equivalent Reflections of solar glazings, allowing a better assessment of the performance cost impact of low optical efficiencies of its components. Combination of both tools shows that, in high quality collectors, a reduction in the number of equivalent reflections brings about pronounced increases in heat delivery capability.

53027 Optimization of the flow passage geometry for air heating solar collectors. Shewen, E.C.; Hollands, K.G.T. (Univ. of Waterloo, Ontario). pp 1.1.2.1-1.1.2.12 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

The flow passage geometry for air heating solar collectors of the underflow type has been examined from the point of view of maximizing the collector efficiency for a specific pressure drop. Parameters studied include the absorber to air stream heat transfer coefficient, the flow passage dimensions, the pressure drop and the air flow rate. A generalized study of improving the heat transfer coefficient for a specified pressure drop is presented. This study has led to a novel air heater design referred to as the short path concept.

53028 Performance analysis of a flat-plate solar collector using forge-fin tubes. Schenk, K.F.; Dua, C.R.; Munoz, J.T. (Univ. of Ottawa, Ontario). pp 1.1.3.1-1.1.3.14 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

In this paper the performance of a flat-plate solar collector using forge-fin tubes is evaluated on the basis of ASHRAE Standard 93. The proposed collector uses a flat-plate absorber with internally finned tubes embedded half-way in the absorber plate. The purpose of these internal fins in the tubes is to enhance the heat transfer between absorber and fluid. The collector has been designed, built and tested for its thermal performance at the University of Ottawa. The dimensions of the collector are 1.4 x 0.9 m^2 with a 0.53 mm thick copper absorber plate with forge-fin tubes 17.1 mm in diameter placed at a distance of 19.3 cm between centers. The absorber has been painted with 3M Velvet-Black paint. A double glazed cover made of 1 mm thick Sunlite Premium as glazing material is utilized.

53029 Dimensional relations for free convective heat transfer in flat-plate collectors. Hollands, K.G.T. (Univ. of Waterloo, Ontario). pp 1.1.5.1-1.1.5.12 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

Recently reported free convective heat transfer results applying to geometries similar to those found in flat plate solar collectors are reviewed and interpreted so as to indicate methods for making design decisions for these collectors. Geometries considered are: (1) the plane-parallel inclined air layer such as occurs between the absorber plate and the adjacent transparent cover, and between adjacent transparent covers, in a conventional flat plate solar collector; (2) the inclined air layer contained between one V-corrugated surface, and one flat surface, such as occurs in a flat plate solar collector with a V-corrugated absorber plate; (3) the plane-parallel inclined air layer in which a square-celled or hexagonal-celled honeycomb is placed between the bounding surfaces, such as occurs between the absorber plate and the transparent cover in a honeycomb solar collector; and (4) the plane-parallel inclined air layer in which a set of parallel partitions are inserted between and at right angles to the bounding surfaces, such as occurs in a horizontal slit type solar collector.

53030 Optimization studies on black chrome electroplating variables for solar selective surfaces. Balakrishnan, A.R.; Hollands, K.G.T.; Shewen, E.C.; Niessen, P. (Univ. of Waterloo, Ontario). pp

1.1.6.1-1.1.6.11 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

Black Chrome electroplating variables, namely current density and plating time, were optimized to produce solar selective surfaces - that is surfaces with high short wave absorptivity, α/sub s/, and low long wave emissivity, ϵ/sub l/. Steel samples with a Bright Nickel finish were plated with DuPont Black Chrome at various current densities and plating times. The emissivity and absorptivity were measured using Gier-Dunkle instruments. The α/sub s/ and ϵ/sub l/ were then used in a computer simulation of flat plate solar collectors called WATAIR to obtain F/sub R/tau α bar and F/sub R/U bar/sub L/. These were then used in another simulation called F-CHART to obtain the collector array area required for a particular house and fraction solar in Ottawa, Ontario. The plating variables giving the α/sub s/ and ϵ/sub l/ combination that yielded the lowest collector array area was then determined. The plating variables were also optimized using the P-factor method which yields seasonal efficiencies for collectors in a particular location and fraction solar once F/sub R/tau α bar and F/sub R/U bar/sub L/ values are known. Results of tests to determine the resistance of the selective surfaces to humidity are also presented.

53031 Thermal performance evaluation of a flat-plate cylindrical parabolic concentrator and a flat-plate collector. Singh, P.; Schenk, K.F. (Univ. of Ottawa, Ontartio). pp 1.2.2.1-1.2.2.13 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

In this paper thermal performance characteristics of a flat-plate cylindrical parabolic concentrator (CPC) have been experimentally determined and compared with a conventional type flat-plate solar collector. Both the collectors were designed, built, and tested under outdoor conditions during winter at the University of Ottawa. The flat-absorber cylindrical parabolic concentrator utilizes all the important design characteristics of a flat-plate collector. This proposed collector design utilizes four identical parabolic channels which were placed adjacent to each other. Each channel consists of a cylindrical parabolic reflecting surface, and a flat-plate absorber blackened on both the front and the back sides was placed along the focal axis of the reflecting surface. To reduce the thermal losses from the absorber two transparent covers of Sun-Lite premium were used as glazing which also protects the reflecting surfaces from dust, snow, etc.

53032 Solar collector thermal performance test for developmental programs. Shewen, E.C.; Hollands, K.G.T. (Univ. of Waterloo, Ontario). pp 2.2.1.1-2.2.1.13 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

An alternative thermal test procedure for solar collectors to that described in ASHRAE Standard 93-77 is described. Particularly suited to in-house developmental programs, the method permits a substantial reduction in the time required for test completion, while yielding an accuracy that should be comparable, for a given type of design. Considerable use is made of indoor heat loss testing and only one outdoor test is required. In this paper the method is outlined and a procedure for correcting the results to standard ambient conditions is described. A description of a test apparatus for air-heating collectors, built at the University of Waterloo is given and some experience in design of mixers and thermocouple collars is reported.

53033 New approaches for the appropriate use of solar energy in northern climates. Lawand, T.A.; Budgen, H.P.; Ives, C.; LeNormand, J.; Skelton, A.; Ghanime, L. (Macdonald College of McGill Univ., Ste. Anne de Bellevue, Quebec). pp 4.1.5.1-4.1.5.18 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

Two examples of the types of approaches which might be followed are illustrated. (1) The Brace greenhouse: a structure adapted to northern conditions, aligned on an east—west axis with the northern wall, insulated, with a reflective layer on the interior. Coupled with a heat storage system and a night cover, overall heat loads can be considerably reduced. Attached to buildings, this can offer an interesting solution for the economical provision of additional space and surplus heat which can be integrated into the building system. (2) The Total Roof Canopy Solar Collector: So as to avoid the problem of rows of solar collectors on building roofs, the replacement of the roof membrane, and the problems of freezing in solar collectors, total transparent roof canopies have been developed which permit the use of the entire roof as a solar collector. It is expected that this will produce a more efficient and more economical solution to solar heating of flat roofed buildings.

53034 Cost effective vertical air/water solar heating collector. Markowitz, T.H.; Hummel, R.L. (Univ. of Toronto, Ontario). pp 5.1.4.1-5.1.4.12 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

The vertical air/water collector combines the low cost and reliability of the air system with the storage advantages of the water system. The heat exchanger required in a water system to transfer heat from storage is also used to transfer heat to storage. The vertical slope and the use of light materials reduce the cost of manufacture and installation. The vertical slope is suitable for Canadian winter conditions, when the solar altitude is less than 30^0, and when snow reflection adds to solar heat gains. The vertical slope is suitable for retrofit to existing buildings. The air collector has several features which improve useful heat gains and suppress heat losses. Radiation heat losses are suppressed by using a selective black absorber surface. Convection losses are minimized by shielding the window from the absorber by a downward moving slow current of relatively cool air, and by periodic removal of the hot boundary layer from the absorber front to the absorber back.

53035 Collector and storage efficiencies in solar heating systems. Hollands, K.G.T.; Chinneck, J.W.; Chandrashekar, M. (Univ. of Waterloo, Ontario). pp 6.1.1.1-6.1.1.13 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

A general definition of the efficiency of a solar collector operating in a solar energy system is presented which gives a fair method of comparison of different collectors operating in that particular application. Based on comparison between the area required for the actual collector and that of a perfect collector - both giving the same fraction solar - the definition permits the definition of the average value of the collector input parameter, P = (T/sub fi/ - T/sub a/)/S. The concept of the perfect collector also leads to a fair definition for the efficiency of the storage component in a solar heating system. These parameters are evaluated for the special case of residential space heating and service hot water systems of the standardized f-chart type operating in a number of Canadian cities. Simple methods for collector comparisons result from the study and indications are that a simple solar system design method will follow.

53036 Honeycomb heat trap: its application in flat plate solar collectors. Hart, D. (Watershed Energy Systems Ltd., Toronto, Ontario). pp 1.1.7.1-1.1.7.10 of Renewable alternatives. Volume 2. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

A collector has been developed incorporating a heat trap constructed of teflon film, using design parameters developed at the University of Waterloo. Some properties of the heat trap are discussed, and test results from the Ontario Research Foundation are presented which substantiate the low cover losses predicted by theory.

53037 First year of solar collector testing at Ontario Research. Bertram, R.W.; Norgate, G. (Ontario Research Foundation, Mississauga). pp 2.2.2.1-2.2.2.16 of Renewable alternatives. Volume 2. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

The solar collector thermal test facility which was set up at Ontario Research was discussed at the SESCI Conference in Edmonton in 1977. After a year of testing a wide variety of collectors under a wide variety of conditions, a great deal has been learned about the measurement of various collector parameters and their significance in collector design. The various problems encountered in solar collector testing and the means by which they were solved will be described and comments made on the interpretation of results obtained.

53038 Studies on solar collector performance at NRC. Harrison, S.J.; Sasaki, J.R. (National Research Council of Canada, Ottawa, Ontario). pp 2.2.3.1-2.2.3.12 of Renewable alternatives. Volume 2. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

As part of NRC's responsibility for the development of solar heating standards and test methods, a facility has been established at the Division of Building Research to obtain data on the thermal performance and durability of solar collectors. A variety of solar collectors are being tested to determine the factors that affect their performance and life. A review of testing procedures is underway to assess their suitability for use in Canada. This paper describes the solar calorimeter apparatus and the in-house activities currently being pursued at DBR.

HEAT STORAGE

REFER ALSO TO CITATION(S) 52814, 52895, 52896, 52897, 52898, 52909, 52937, 52965

53039 (COO—2993-1) **Melting in phase-change thermal storage media. Final report.** Sparrow, E.M.; Ramsey, J.W. (Minnesota Univ., Minneapolis (USA). Dept. of Mechanical Engineering). 1978. Contract EY-76-S-02-2993. 90p. P 05/MF A01.

The research has focused on melting caused by a tubular heat source embedded in a solid phase-change medium. Separate studies were performed with the heater positioned with its axis horizontal and with its axis vertical. The motivation for investigating both orientations is that they correspond to those of proposed bulk-type storage configurations. In addition, the direction of th gravity force relative to the heating surface is different in the two cases and this causes differences in the buoyancy forces that act on the liquid generated by the melting process. Two phase-change media were employed in the experiments: (a) the eutectic mixture of sodium nitrate and sodium hydroxide--melting temperature of 244°C (471°F), (b) naphthalene--melting temperature of 80°C (176°F). The analysis was carried out on a specific fluid or a temperature level. The experimental results encompass information on both the heat transfer coefficient at the heated surface and on the size and shape of the melt zone. Since the heat transfer coefficient relates the heat flux and the temperaure difference, it is directly applicable to design. Furthermore, the knowledge of the size and shape of the melt zone enables decisions to be made about the placement of adjacent elements of a multiple heat source array. The analysis also provides surface heat transfer coefficients and melt layer size and shape. (WHK)

53040 (SAND—78-8511, pp 254-272) **Honeywell latent heat thermal storage subsystem research experiment testing at NSP.** LeFrois, R. Nov 1978.

In Department of Energy Large Solar Central Power Systems semiannual review.

The design, development, and planned testing of the $NaNO_3$-NaOH latent heat storage system for the 10-MW/sub e/ Solar Pilot Plant Program are described. (WHK)

53041 (SAND—78-8511, pp 273-281) **Thermal energy storage fluids testing and analysis.** Burolla, V.P. (Sandia Labs., Livermore, CA). Nov 1978.

In Department of Energy Large Solar Central Power Systems semiannual review.

Although the choice of a working fluid for the thermal energy storage subsystem has been narrowed to two or three candidates over the past years, work has continued on efforts to better understand and quantify the yearly fluid replenishment rates that will be encountered in the Barstow pilot plant. The objective at Sandia has been to obtain precise fluid replenishment rates for thermal storage systems, with and without rock and sand, using Caloria HT43 or Therminol 66 as the working fluid. The results of the Sandia tests are reported along with some comments on the need for standardization in fluid testing, the variation in fluid properties, and the remaining potential areas of investigation.

53042 (SAND—78-8511, pp 282-290) **Extended testing of thermal storage heat transfer fluids.** Morgan, G.R. (McDonald Douglas/Rocketdyne, Canoga Park, CA). Nov 1978.

In Department of Energy Large Solar Central Power Systems semiannual review.

53043 (SAND—78-8511, pp 291-305) **Storage fluid maintenance study.** Beshore, D.G. Nov 1978.

In Department of Energy Large Solar Central Power Systems semiannual review.

Thermal energy storage concepts using hydrocarbon oils are being considered by the Department of Energy in first-generation solar thermal power feasibility studies and plant development efforts. Martin Marietta Aerospace, Denver Division, is currently investigating the thermal degradation characteristics of Exxon's Caloria HT43 oil. The program was divided into two phases. Phase I has studied the thermophysical effects of oil degradation in a partially vented storage tank at 316°C (600°F) for a period of 1000 hours. Phase II has examined the effect of a sidestream processor (vacuum distillation column) on oil degradation in a vented storage tank. Testing in both phases has been completed, and the final report is currently being written. Test results to date indicate that the thermal degradation process is autocatalytic. Therefore, both tank venting and oil reprocessing can actually reduce the degradation rate.

53044 (SERI/RR—54-164) **Low temperature thermal energy storage: a state-of-the-art survey.** Baylin, F. (Solar Energy Research Inst., Golden, CO (USA)). Jul 1979. Contract EG-77-C-01-4042. 119p. P 06/MF A01.

The preliminary version of an analysis of activities in research, development, and demonstration of low temperature thermal energy storage (TES) technologies having applications in renewable energy systems is presented. Three major categories of thermal storage devices are considered: sensible heat; phase change materials (PCM); and reversible thermochemical reactions. Both short-term and annual thermal energy storage technologies based on prinicples of sensible heat are discussed. Storage media considered are water, earth, and rocks. Annual storage technologies include solar ponds, aquifers, and large tanks or beds of water, earth, or rocks. PCM storage devices considered employ salt hydrates and organic compounds. The sole application of reversible chemical reactions outlined is for the chemical heat pump. All program processes from basic research through commercialization efforts are investigated. Nongovernment-funded industrial programs and foreign efforts are outlined as well. Data describing low temperature TES activities are presented also as project descriptions. Projects for all these programs are grouped into seven categories: short-term sensible heat storage; annual sensible heat storage; PCM storage; heat transfer and exchange; industrial waste heat recovery and storage; reversible chemical reaction storage; and models, economic analyses, and support studies. Summary information about yearly funding and brief descriptions of project goals and accomplishments are included.

53045 (STUDSVIK/E3—79/3) **Demonstration project for solar heating of heavy oil in rock cavities.** Zinko, H. (Studsvik Energiteknik AB, Nykoeping (Sweden)). Jan 1979. 25p. (In Swedish). U 02/MF A01.

Earlier investigations have shown that the heating of stored oil is a promising application for using solar heat on an industrial scale, since the oil store itself represents the whole store of a year of collected thermal energy. The demonstration plant, which will probably be situated at Marviken, Sweden, is proposed to deliver 150 MWh/year. Five different solar collector systems are planned. Since these systems will work under identical climatic conditions the investigation will give comparable information on costs and performances of the systems. Furthermore information on the heat distribution system including heat exchanger, buffer and adjustment is obtained.

53046 (STUDSVIK/E3—79/6) **Comparisons of performances of three different methods for the storage of low temperature heat (solar heat) which will be used for space heating.** Hedman, H.; Zinko, H.; Nowacki, J.E. (Studsvik Energiteknik AB, Nykoeping (Sweden)). Feb 1979. 61p. (In Swedish). U 04/MF A01.

The performances of different methods for heat storage are compared. Initial costs and energy costs for the different systems are calculated. The importance of the energy losses in the heat storage systems is discussed. The results of this investigation show that air supported solar heat is more favorable to use for individual small houses than water supported solar heat.

53047 **Heat storage systems.** Dumbeck, R.F. US Patent 4,153,047. 8 May 1979. Filed date 13 Jul 1977. 10p.

The present invention provides systems for transfer of heat such as useful in solar energy systems. A heat storage medium is used, preferably salt conditioned by anticaking anti-corrosive treatment whereby hydrated salts have increased utility by remaining granular during severe temperature and humidity changes, permitting the salt to be used more effectively as a heat storage and exchange medium. The heat storage medium is coated with a heat transfer liquid preferably silicone oil which functions to preserve salt, prevent rust and corrosion therefrom, and to serve as an efficient heat transfer medium between the heat storage medium and transfer means such as heat coils. A solar heat system comprises a solar energy concentrator, a heat input system to a granular particle storage medium,, and a heat output system extracting heat from the storage medium.

53048 **Residential and commercial thermal storage.** Lorsch, H.G.; Kauffman, K.W. (Franklin Inst. Research Labs., Philadelphia, PA). pp 309-324 of Energy from the sun. Chicago, IL; Institute of Gas Technology (1978).

From Symposium on energy from the sun; Chicago, IL, USA (3 Apr 1978).

The choices of thermal storage media and the design and operation of storage devices for the heating and cooling of buildings with solar energy are described. Thermal storage by means of sensible, latent, and chemical energy is defined, and the advantages and disadvantages of each technology for particular applications are contrasted. Present practice in both active and passive solar heating systems uses sensible heat storage in rock or water because of mechanical simplicity and low cost. Latent heat storage using the melting and freezing of solids may be accomplished in one-third to one-fifth of the volume required for water, but high heat transfer costs with latent storage and a past philosophy which overemphasized low storage medium cost at the expense of poor performance have limited its commercial adoption. It is shown that latent storage is most attractive for passive solar heating. Areas of active research

and development on latent and chemical storage are briefly reviewed.

53049 Studies on the effect of bed aspect ratios and pressure drop on flow distribution in rock bed storage systems for solar energy applications. Balakrishnan, A.R.; Sullivan, H.F. (Univ. of Waterloo, Ontario). pp 1.3.1.1-1.3.1.11 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

The choice of an optimum aspect ratio in designing rock bed storage devices for solar heating is very important. Too high an aspect ratio leads to an unnecessarily high pressure drop and hence high blower requirements. Too low an aspect ratio (shallow beds) will yield maldistributed flow in the bed and poor usage of the storage volume. To determine the optimum aspect ratio, experiments were conducted on a fully instrumented rock bed of size 2.6 m x 2.6 m x 2.6 m. The rocks were of size 2.54 cm rounds and the bed was loaded 0.3048 m at a time. At each level (aspect ratio), flow distribution and pressure drop measurements were made for various air flow rates. Results indicate that aspect ratios approaching a value of one are to be preferred. However, in addition to this, it is necessary to have a flow rate through the bed that will produce a pressure drop of around 35 N/m^2 to ensure even flow distribution.

53050 Model stratified layer solar pond with enhanced heat storage. Wilkins, E.S.; Pinder, K.L. (Univ. of British Columbia, Vancouver). pp 1.3.2.1-1.3.2.9 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

The heat storage capacity of a small (65 x 65 x 25 cm) stratified layer solar pond was enhanced by placing black plastic containers filled with solid inorganic hydrates in the bottom of the pond. Two hydrates were tested, sodium sulfate decahydrate and sodium dibasicphosphate heptahydrate. Sodium sulfate decahydrate did not reform on cooling, but the phosphate hydrate was followed through many cycles. Thus water circulating under the bottom partition in the solar pond could be used to recover this stored heat when needed.

53051 Distributed energy storage for solar applications. Holt, L.; Scheithauer, R. (Department of Energy, Washington, DC). pp 1.3.4.1-1.3.4.9 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

Decision tools have been developed to evaluate and compare the total costs of supplying residential heating and cooling services with alternative energy technologies. Given input information on electric utility plant capacity, forced-outage rates, scheduled maintenance requirements, and cost data for individual generating units, the model uses hourly utility load data and synoptic weather data to simulate both system loads and costs as a function of heating/cooling technology penetration. The results of distributed storage analysis efforts are used to: (1) evaluate cost-competitiveness and technical performance of specific energy storage technologies; (2) determine the optimum size of storage units for space heating and cooling applications; (3) assess market needs and estimate potential market penetration and commercialization strategies for storage technologies; and (4) specify R and D requirements for a national program to develop energy storage technologies.

GEOTHERMAL ENERGY

REFER ALSO TO CITATION(S) 53353

53052 (PB—291023) **Synthesis of recent advances in geothermal energy technologies.** Nakamura, Y. (Jet Propulsion Lab., Pasadena, CA (USA)). Feb 1977. 439p. Y A19/MF A01.

The report is a compilation of reports gathered from project researchers since 1972, and is intended to acquaint the research community and industry with new findings. It is organized in seven sections: (1) Geosciences of Geothermal Resources; (2) Advanced Exploration Technology; (3) Geothermal Reservoir Engineering; (4) Brine Chemistry and Materials Engineering; (5) Geothermal Engineering Applications; (6) Geothermal Environmental Research; and (7) Legal and Institutional Studies. Each section includes an introduction which defines the purpose and scope of the research area, a summary of results, and a brief note on the state-of-the-art. A listing of documents recommended for additional reading is included in some of the sections.

RESOURCE STATUS AND ASSESSMENT

53053 Prospects for geothermal energy. Norris, T.E.; Shaw, J.R. (Merz and McLellan, Newcastle-upon-Tyne, England). pp 11-16 of Steam at work: industrial and marine steam plant. New York, NY; Mechanical Engineering Publications Limited (1977).

From Conference on steam at work: industrial and marine steam plant; Manadon, Plymouth, UK (10 May 1977).

After outlining the source of geothermal energy and mechanisms by which it occurs and can be produced, forecasts of geothermal potential are contrasted with present usage. Prospecting methods are outlined and a distinction is drawn between large scale and small scale developments. The paper concludes with a forecast of future usage worldwide and in the UK. Caution is advocated assessing hopes for the future.

USA

REFER ALSO TO CITATION(S) 53112

53054 (NMEI—10-2) **Geothermal development and production of electricity in the Southwestern United States.** Nowotny, K.R.; Rao, C.R. (New Mexico State Univ., Las Cruces (USA). New Mexico Energy Inst.; New Mexico Univ., Albuquerque (USA). Dept. of Economics). Oct 1978. Contract EG-77-S-04-3992. 56p. P 04/MF A01.

A computer simulation model (GIRORA-Electric) is developed to study the economics of power generation from high temperature geothermal resources. GIRORA-Electric is a discounted cash flow investment model which evaluates the rate of return on producers' capital investment. This model consists of two major submodels: the exploration and development of a geothermal anomaly by a producer; and the purchase of geothermal fluid by a utility developer. The primary output of the model is a calculated rate of return on the capital investment earned by the geothermal producer. The results of the sensitivity analysis of the model subject to changes in physical and economic parameters are given. Using the results of the economic analysis, the high temperature geothermal sites (temperatures greater than 150°C) in the Southwestern United States are examined for economic viability for power generation. The total amount of power that can be brought on line in the Southwest Region is estimated under three different scenario assumptions. An econometric model is developed to estimate the total demand for electricity in the Southwest Region. From this demand and supply estimates, the amount of geothermal energy that can be utilized is also estimated.

GEOLOGY, HYDROLOGY, AND GEOTHERMAL SYSTEMS

REFER ALSO TO CITATION(S) 53104

53055 (COO—5085-2) **Energy analysis of geothermal energy supply systems. Second quarterly report.** Herendeen, R.A. (Illinois Univ., Urbana (USA)). 9 Apr 1979. Contract ET-78-S-02-5085. 5p. P 02/MF A01.

An initial calculation was performed for hot-dry-rock (HDR) systems with emphasis on drilling costs. Using currently available data, a preliminary calculation for the net energy ratio of a 50 MW HDR plant was performed. The effect of using dynamic input-output models as opposed to static models is discussed. (MHR)

53056 (LA—7906-T) **Flow near the outlet of a geothermal energy reservoir.** Murphy, H.D. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 274p. P 12/MF A01.

Thesis.

Steady, incompressible flow converging radially between two stationary, parallel plates was investigated both numerically and experimentally. Flow ranges investigated were laminar, turbulent, and transitional. For laminar flows at dimensionless radii ($2r\sqrt{\pi\nu}/Qt$) much greater than one the velocity profile becomes parabolic and invariant. At radii less than one a boundary layer character evolves with an approximately uniform core region and the boundary layer thickness decreases from one-half the disk spacing to values proportional to the local radii as the flow accelerates towards the center. At large radii the friction factor approaches the classic value obtained for fully developed rectilinear flow between infinite plated, $6\nu/Vt$, but at small radii it approaches the constant $2.17/\sqrt{R_0}$, where R_0 is an overall Reynolds number based on the volumetric flow rate and the disk spacing and is independent of radius. Tabular and graphical results are provided for the intermediate range of radii, where both viscous and inertial effects are important, and exact analyses were not available.

53057 (LBL—8883, pp 59) **Pressure field propagation and density currents.** Bodvarsson, G. (Oregon State Univ., Corvallis). 1978.

From 2. international well-testing symposium; Berkeley, CA, USA (25 Oct 1978).

53058 (LBL—8883, pp 60-70) **Pressure transient analysis for geopressured geothermal wells.** Garg, S.K.; Riney, T.D.; Pritchett, J.W. (Systems, Science and Software, La Jolla, CA). 1978.

From 2. international well-testing symposium; Berkeley, CA, USA (25 Oct 1978).

Analytical solutions presently exist which form the basis for practical analysis of pressure transient data from isothermal single-phase (water, oil) and isothermal two-phase (oil with gas in solution, free gas) reservoir systems. A numerical model embodying the important mechanisms operating in geopressured geothermal reservoir systems has been applied in a series of parametric calculations simulating well drawdown/buildup to assess the applicability of the classical petroleum engineering/hydrology analysis procedures to geopressured systems. More specifically, the effects of irreversible (formation) compaction and methane saturation (and the associated changes in porosity, absolute permeability and/or total mobility) are studied. It is found that conventional well test analysis may be expected to yield reliable formation permeability (or mobility) data even when compaction occurs and methane evolves out of solution, but storativity estimates will be unreliable. Drawdown and buildup test data together can be used to diagnose irreversible compaction response of the formation.

USA

REFER ALSO TO CITATION(S) 53073, 53093, 53097, 53100

53059 (SAN—1313-1) **Inversion of commbined geophysical data for determination of structure beneath the Imperial Valley geothermal region. Final report.** Savino, J.M.; Rodi, W.L.; Goff, R.C.; Jordan, T.H.; Alexander, J.H.; Lambert, D.G. (Systems, Science and Software, La Jolla, CA (USA)). Sep 1977. Contract EY-76-C-03-1313. 87p. (SSS-R—78-3412). P 05/MF A01.

A program aimed at developing formal numerical modeling data sets for defining the earth's near surface environment is discussed. The numerical modeling procedures developed and the results obtained in these areas are described. The conclusions are enumerated. (MHR)

NON-USA

REFER ALSO TO CITATION(S) 53067

53060 (NP—23233) **Geothermal indications and hot springs of Hokkaido, Japan (B): western area. Report of the Geological Survey of Hokkaido.** 1977. 211p. (In Japanese). K .

In the northern part of southwestern Hokkaido, there are several well known hot springs, including Doyakohan, Noboribetsu, and Jozankei. A total of about 61 springs are present, their temperatures ranging from 25 to 98.4°C. The total hydrothermal capacity amounts to about 79.4 kl/min, of which 19.7 kl/min are naturally erupted and 59.7 kl/min are produced from boreholes. The greatest outputs are from the Takeura area (Shiraoi-cho) and the Noboribetsu hot springs. The output of the northern springs is about 3 times as great as the output of springs in the south-central portion of southwestern Hokkaido. The greatest amount of energy discharged is at Noboribetsu (52.2 x 10^7 cal/min), followed by Takeura (51.5 x 10^7 cal/min). The springs at Doyakohan, Noboribetsu, and Niseko are accompanied by the discharge of CO_2 gas. The Chitose-Shikotsuko springs discharge hot methane, and those at Otake-Kitayuzawa, Shiraoi-Kojohama, Takeura, Kawamata, Honcho, and Niimi are accompanied by the discharge of nitrogen. Two large maps are included as appendices, and 228 references are provided.

53061 (NP—23245) **Report on the precision investigation for the geothermal development of Aso, 1975.** May 1976. 119p. (In Japanese). K .

Two structural drillings were made in Takenoyu and Teraono. During the period of November 1975 to March 1976, cores were taken down to 500 m, and electrical logging, temperature logging, and pressurization tests were performed. No high temperature reservoirs were located within a depth of 500 m, but the conditions of faulting and temperature distribution are not entirely unfavorable. Approximately 66 maps, tables, logs, and borehole sections are provided.

GEOTHERMAL EXPLORATION AND EXPLORATION TECHNOLOGY

REFER ALSO TO CITATION(S) 53097

53062 (APL/JHU-EQR—79-1) **Energy programs at The Johns Hopkins University Applied Physics Laboratory. Quarterly report, January—March 1979.** (Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.). Apr 1979. Contract EC-77-C-01-5085;EX-76-A-29-1030;EX-76-A-36-1008. 31p. P 03/MF A01.

Work on developing energy resources, utilization concepts, and storage methods is summarized and divided into three sections. The first, Geothermal Energy Development Planning, contains reports on the progress of those geothermal-related tasks where effort was concentrated during the quarter. The tasks include an ongoing Atlantic Coastal Plain Geothermal Energy Market Survey, the Delmarva Geothermal Development Prospectus, Evaluation of Federal Strategies for Hydrothermal Developments, and comments on limited tasks performed in support of the major tasks. The second section, Operational Research, Hydroelectric Power Development, includes reports on a method for quantifying institutional constraints and on institutional and regulatory restraints in New Jersey. The third section, Energy Conservation and Storage Techniques, contains a report on flywheel development.

53063 (IDO—1583-T1) **Study of private enterprise development on the Raft River KGRA. Final progress report.** Green, S.J.; Brown, W.S.; Meldrum, P.D. (Terra Tek, Inc., Salt Lake City, UT (USA)). Jul 1977. Contract EY-76-C-07-1623. 73p. P 04/MF A01.

Information, analysis, and conclusions based on the small for-profit venture business model are presented. The necessary tasks are described and progress is reviewed. Water availability and business analysis problems are described. Included in the appendix are materials on land availability, characterization of geothermal resources under Idaho law, and greenhouse analysis and geothermal applications. (MHR)

GEOPHYSICAL TECHNIQUES AND SURVEYS

REFER ALSO TO CITATION(S) 53059, 53061

53064 (RLO—2426-T2-3) **Geothermal data-base study: mine-water temperatures. Final report.** Lawson, D.C.; Sonderegger, J.L. (Montana Bureau of Mines and Geology, Butte (USA); Montana Coll. of Mineral Science and Technology, Butte (USA)). Jul 1978. Contract EY-76-S-06-2426. 40p. P 03/MF A01.

Investigation of about 1,600 mines and prospects for perennial discharge resulted in the measurement of temperature, pH, specific conductance, and discharge at 80 sites to provide information for a geothermal data base. Measurements were made in the fall, winter, and late spring or early summer to provide information about seasonal variability. None of the temperatures measured exceeded the mean annual air temperature by 15°F, but three areas were noted where discharges were anomalously warm, based upon high temperatures, slight temperature variation, and quantity of discharge. The most promising area, at the Gold Bug mine in the Little Rockies, discharges water averaging 7.3°C (12.1°F) above the mean annual air temperature. The discharge may represent water heated during circulation within the syenite intrusive body. If the syenite is enriched in uranium and thorium, an abnormal amount of heat would be produced by radioactive decay. Alternatively, the water may move through deep permeable sedimentary strata, such as the Madison Group, and be discharged to the surface through fractures in the pluton.

GEOCHEMICAL TECHNIQUES AND SURVEYS

53065 (CONF-790906—22) **Geochemical modeling at Raft River.** Allen, C.A.; Chaney, R.E.; McAtee, R.E. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 8p. P 02/MF A01.

From Geothermal Resources Council annual meeting; Reno, NV, USA (24 Sep 1979).

Chemical analysis of water from three depth regimes at the Raft River KGRA indicate the presence of at least two distinct hydrothermal fluids. One fluid predominates in the fracture system on the west side of the valley, known as the Bridge Fault. This fluid is characterized by low conductivity (2,000 to 3,000 μs) and 6 to 9 μg/ml F^-. The second fluid, encountered in the center of the valley, appears to be associated with the Narrows Structure and is characterized by a conductivity of 6,000 to 11,000 μs and F^- of 3 to 6 μg/ml. Contour mapping of conductivity and Cl^-/F^- ratios indicates upwelling of both deep geothermal fluids into the shallow system. This recharge into the intermediate and shallow zones produces high-conductivity water which is used for irrigation. Application of a simple mixing model shows that all the water sampled in intermediate and deep zones can be described by mixtures of two nearly pure fluids. One mechanism, consistent with the known data, is deep upwelling of a highly mineralized fluid which is heated by the basement rock and then penetrates sediment layers through fractures. The second fluid is relatively recent meteoric water conductively heated by the basement rock.

EXPLORATORY DRILLING AND WELL LOGGING

53066 (CONF-790906—21) **Chemical logging: a geothermal technique.** McAtee, R.E.; Allen, C.A. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 5p. P 02/MF A01.

From Geothermal Resources Council annual meeting; Reno, NV, USA (24 Sep 1979).

Chemical logging studies conducted at the Department of Energy's Raft River Geothermal Test Site in south central Idaho resulted in the development of a technique to assist in geothermal well drilling and resource development. Calcium-alkalinity ratios plotted versus drill depth assisted in defining warm and hot water aquifers. Correlations between the calcium-alkalinity log and lithologic logs were used to determine aquifer types and detection of hot water zones 15 to 120 m before drill penetration. INEL-1 at the Idaho National Engineering Laboratory site in eastern Idaho represents the second area where this was applied. Calcium-alkalinity ratio, lithologic, and compensated neutron logs correlated well and were used to define the water-producing zones penetrated by the well. This well is located in an area of different geologic and hydrologic characteristics.

53067 (NP—23826) **Second stage report on geothermal exploration in Leyte, Philippines.** (Kingston, Reynolds, Thom and Allardice Ltd., Auckland (New Zealand)). Feb 1978. 101p. P 06/MF A01.

Since December 1973 twelve temperature gradient wells (maximum depth 2000 ft) and three deep (over 5000 ft) exploration wells have been drilled in an area of approximately 20 square kilometers, located in the area generally known as the Tongonan Geothermal Field. Well completion reports are presented for five of these wells covering: core petrology, alteration product significance, and well water geochemistry. As a result of the favorable temperature gradient encountered in TGE-10 and an emerging anomaly of low apparent resistivity, deep exploration wells were sited to test initially the 10 ohm metro apparent resistivity closure. The first three wells in this programme have all had favorable results, with maximum temperatures in excess of 320°C being recorded at 6000 ft depth.

53068 (NP—23832) **Negros 1 and Negros 2 well completion report. Geothermal exploration project, Southern Negros, Philippines.** (Kingston, Reynolds, Thom and Allardice Ltd., Auckland (New Zealand); PNOC Energy Development Corp., Metro Manila (Philippines)). Jul 1978. 23p. U 02/MF A01.

Pertinent data, the drilling summary, the casing program, well completion, drill bits and hole openers, materials consumed, and geology encountered are reviewed for each of the two wells. (MHR)

53069 (NVO—1558-1) **Atlantic coastal plain geothermal test holes, New Jersey. Hole completion reports.** Cobb, L.B.; Radford, L.; Glascock, M. (Gruy Federal, Inc., Houston, TX (USA)). Mar 1979. Contract ET-78-C-08-1558. 163p. P 08/MF A01.

A description of the Atlantic Coastal Plains Geothermal Drilling Program and data for the following Geothermal test holes drilled in New Jersey are summarized: Site No. 40, Fort Monmouth; Site No. 41, Sea Girt; Site No. 39-A, Forked River; Site No. 38, Atlantic City; and Site No. 36, Cape May.

53070 (NVO—1558-2) **Atlantic coastal plain geothermal test holes, Delaware.** Cobb, L.B.; Radford, L.; Glascock, M. (Gruy Federal, Inc., Houston, TX (USA)). Mar 1979. Contract ET-78-C-08-1558. 132p. Dep. NTIS, PC A07/MF A01.

Intermittent drilling operations were carried out in Delaware beginning on September 7, 1978, and completed November 10, 1978. During that period five wells were drilled to approximately 1000 feet and cased with 4-1/2" seamless casing cemented to the surface. Each hole was completed by installation of wellhead equipment to permit geothermal test measurements and filling the hole with water containing corrosion inhibitor.

53071 (PB—290173) **Microcrack technology for geothermal exploration and assessment. Final report, 1 March 1976-31 August 1978.** Simmons, G. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Earth and Planetary Sciences). 31 Aug 1978. 297p. Y A13/MF A01.

Repeated fracturing and fracture sealing were observed in core samples from six geothermal areas. Both fracture porosity and morphology vary widely. The minerals that seal fractures show significant temporal variations. Water-rock reactions and alteration often produce low density or hydrous phases that further seal and block cracks. Such parameters as hydraulic permeability and electrical conductivity that influence the geologic environment or serve as geothermal indicators are dependent on the fracture state of the rock. The microfractures from these geothermal areas have several distinctive characteristics which are explained. The microfractures in geothermal rocks reflect the dynamics of the geothermal system. The results of this investigation are applicable to several problems encountered in the exploration for geothermal areas and evaluation of the reservoir: (1) locating the geothermal area; (2) interpretation of electrical surveys; and (3) prediction of reservoir characteristics and reservoir behavior during exploitation.

53072 (NP—23825) **First stage report on geothermal exploration in Leyte, Philippines.** (Kingston, Reynolds, Thom and Allardice Ltd., Auckland (New Zealand)). [nd]. 63p. U 04/MF A01.

An exploratory drilling program for geothermal energy at the Tongonan geothermal area in Leyte, Republic of Philippines was accepted by the New Zealand and Philippine Governments as a technical co-operation project in 1973. Seven test wells were drilled to a maximum depth of 2000 ft. Two wells (TGE-5 and TGE-5A) encountered the hot, high chloride water which is discharging at th Banat-i springs in the Bao Valley. TGE-5A discharged low enthalpy steam and hot water, but rapid clogging of the well by aragonite prevents the use of the steam for the production of electrical power. TGE-3, TGE-7 and TGE-6 water samples contained 10 to 50%, 5% and a trace, respectively of the high chloride waters, probably from the same source as the waters encountered in TGE-5 and TGE-5A. TGE-1 and TGE-2 contained steam heated meteoric waters only. Drilling and geochemical results would indicate the heat source and hot water aquifer lie to the north or east of wells TGE-5 and TGE-5A with these wells being on the periphery of the hydrothermal system.

LEGAL AND INSTITUTIONAL ASPECTS

REFER ALSO TO CITATION(S) 53063

ECONOMIC AND FINANCIAL ASPECTS

REFER ALSO TO CITATION(S) 53054

ENVIRONMENTAL ASPECTS AND WASTE DISPOSAL

REFER ALSO TO CITATION(S) 53099

53073 (CONF-790906—20) **Injection at Raft River: an environmental concern.** Spencer, S.G. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 4p. P 02/MF A01.

From Geothermal Resources Council annual meeting; Reno, NV, USA (24 Sep 1979).

Portions of document are illegible.

Injection is an acceptable disposal method for geothermal fluid; however, use of injection can be limited by environmental considerations. This is the case in Raft River. The primary concern is that injection will affect either the quality or quantity of irrigation water in the closed groundwater basin. Data indicate that there is a natural migration of geothermal fluids into shallower aquifers and this migration is thought to be fracture-controlled. A series of wells have been drilled to monitor the response of shallow aquifers to intermediate-depth injection. Several of these monitor wells have shown marked pressure response to injection in RRGI-4 and RRGI-6. These data will be used to evaluate both current injection practices and fluid disposal alternatives in Raft River.

53074 (CONF-790906—25) **Snake River Basin environmental program.** Spencer, S.G.; Sullivan, J.F. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 8p. P 02/MF A01.

From Geothermal Resources Council annual meeting; Reno, NV, USA (24 Sep 1979).

The Snake River Basin Environmental Program was designed to evaluate existing environmental data with respect to potential geothermal development in eight Known Geothermal Resource Areas (KGRAs) in Idaho. State and federal agencies, public interest groups, consulting groups, and universities participated in the DOE program. Final reports for the program are intended to be utilized as reference documents and planning tools for future environmental studies. Evaluation of the data indicated that the majority of the existing data base is adequate for small-scale direct-use developments. The potential impacts of development on water quality and water supply are the primary environmental concern. Preliminary data suggest that subsidence and induced seismicity may be a problem in several of the KGRAs. Sensitive animal species and habitats have been identified in each area; development in the Castle Creek KGRA may be restricted due to the Birds of Prey Natural Area. Two workshops provided public input on concerns and land use planning for geothermal development in Idaho. Based on the data evaluation and public input, a plan for supplementing the existing environmental data base was prepared.

53075 (LBL—8883, pp 29-33) **Cost-effective treatment system for the stabilization of spent geothermal brines.** Van Note, R.H. (Envirotech Corp., San Mateo, CA); Featherstone, J.L.; Pawlowski, B.S. 1978.

From 2. international well-testing symposium; Berkeley, CA, USA (25 Oct 1978).

A treatment system has been developed in which spent geothermal brines from a flash-tank heat-extraction plant are stabilized to permit reinjection of the treated brine while maintaining the integrity of the wells over an extended period. This treatment system is both cost-effective and environmentally sound. It incorporates the following unit process operations: reconstituting the minerals which were dissolved from the geothermal strata formations in a Reactor—Clarifier by solids contact precipitation reactions; polishing of the clarifier effluent in a gravity dual-media filter; thickening and storage of sludge produced in the Reactor-Clarifier; and dewatering of the sludge to an optimum cake moisture suitable for handling and land disposal.

53076 (LBL—8883, pp 78-80) **Geothermal brine injection evaluation methodology.** Quong, R.; Owen, L.B.; Tardiff, G.E. (Univ. of California, Livermore). 1978.

From 2. international well-testing symposium; Berkeley, CA, USA (25 Oct 1978).

Standard oil field methodology adapted to establish brine quality and pre-injection processing requirements to insure long-term injectivity of Salton Sea Geothermal Field (SSGF) effluents is described. The brine processing work was completed in conjunction with a joint Magma-LLL reservoir evaluation program. Standard oil field methodology consists of preliminary coreflooding, filtration and chemical stability tests to establish the potential for reservoir impairment.

53077 (LBL—8883, pp 81-89) **Use of tracers in geothermal injection systems.** Vetter, O.J. (Vetter Research, Costa Mesa, CA). 1978.

From 2. international well-testing symposium; Berkeley, CA, USA (25 Oct 1978).

The use of tracers is critical in geothermal injection systems. The hydrodynamic break-through of reinjected brine can be monitored in a very precise way using tracers. No other method is known which allows produced brine monitoring with the same precision. Thus, precalculated and monitored break-through profiles can be compared and the expected temperature front can be estimated in a very precise way. This use of tracers can be considered a prewarning system. The choice of tracers for geothermal reservoirs is rather limited. Tritiated water, introduced into the reservoir in a controlled manner, is the best choice. However, this monitoring technique eliminates the use of naturally occurring tracers for reservoir studies. The pros and cons for the use of naturally occurring tritium and other tracers are described. Present tracer techniques are hampered by a lack of information on the dispersion coefficient of the tracer in the flowing brine and the precise adsorption characteristics of the tracer on the rock material.

53078 (NP—23251) **Technology assessment of applied techniques for exploitation of geothermal energy.** Apr 1977. 10p. (In Japanese). K

In Collection of outlines of the results of the Sunshine Project in 1976.

Studies were made to elucidate the effects of technological development of natural steam and hot water on the general social and industrial environments. These were followed by studies of enhanced methods for the forecasting of these impacts. The studies included assessments of actual conditions and the preparation of regional models, ranging from rural to urban-fringe situations. The economic implications of geothermal development in various regional situations are discussed, and the models developed provide for the integration of new data and their extrapolation to as yet uncertain situations.

53079 (UCRL—15062) **Environmental overview of geothermal development: the Mono-Long Valley KGRA.** Strojan, C.L.; Romney, E.M. (eds.). (California Univ., Los Angeles (USA). Lab. of Nuclear Medicine and Radiation Biology). Jan 1979. Contract W-7405-ENG-48. 283p. P 13/MF A01.

Major issues and concerns relating to geothermal development were identified and assessed in seven broad areas: (1) air quality, (2) archaeology and cultural resources, (3) geology, (4) natural ecosystems, (5) noise, (6) socioeconomics, and (7) water quality. Existing data for each of these areas was identified and evaluated to determine if the data can be used to help resolve major issues. Finally, specific areas where additional data are needed to ensure that geothermal development is environmentally acceptable were recommended.

53080 **Hydrogen sulfide abatement in geothermal steam.** Woertz, B.B. (to Union Oil Co. of California). US Patent 4,151,260. 24 Apr 1979. Filed date 26 Oct 1976. 10p.

A process is disclosed for reducing the hydrogen sulfide content of geothermal steam during a drilling operation by injecting hydrogen peroxide and an alkali metal hydroxide or calcium hydroxide into a flowing stream containing geothermal steam. Environmentally harmless reaction products are thus formed and the emission of hydrogen sulfide during drilling operations is substantially abated.

GEOTHERMAL POWER PLANTS

REFER ALSO TO CITATION(S) 53054

POWER PLANT SYSTEMS AND COMPONENTS

53081 (CONF-790808—16) **Waste heat rejection from geothermal power stations.** Robertson, R.C. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 70p. P 04/MF A01.

From 18. ASME national heat transfer conference; San Diego, CA, USA (Aug 1979).

Waste heat rejection systems for geothermal power stations have a significantly greater influence on plant operating performances and costs than do corresponding systems in fossil- and nuclear-fueled stations. With thermal efficiencies of only about 10%, geothermal power cycles can reject four times as much heat per kilowatt of output. Geothermal sites in the United States tend to be in water-short areas that could require use of more expensive wet/dry or dry-type cooling towers. With relatively low-temperature heat sources, the cycle economics are more sensitive to diurnal and seasonal variations in sink temperatures. Factors such as the necessity for hydrogen sulfide scrubbers in off-gas systems or the need to treat cooling tower blowdown before reinjection can add to the cost and complexity of goethermal waste heat rejection systems. Working fluids most commonly considered for geothermal cycles are water, ammonia, Freon-22, isobutane, and isopentane. Both low-level and barometric-leg direct-contact condensers are used, and reinforced concrete has been proposed for condenser vessels. Multipass surface condensers also have wide application. Corrosion problems at some locations have led to increased interest in titanium tubing. Studies at ORNL indicate that fluted vertical tubes can enhance condensing film coefficients by factors of 4 to 7.

53082 (COO—4051-36) **Effect of non condensable gases on the performance of geothermal steam power systems.** Khalifa, H.E.; Michaelides, E. (Brown Univ., Providence, RI (USA). Dept. of Engineering). Nov 1978. Contract EY-76-S-02-4051. 39p. P 03/MF A01.

The influencce of dissolved carbon dioxide on the thermodynamic performance of geothermal steam systems is analyzed. The system is divided into its main component: the flash tank, the turbine, the condenser and the gas extraction system, and the effect of non condensables is studied for each. The effect of the noncondensable gas on the output of the whole system is deduced from its effect on the individual components. The analysis of actual systems is preceded by an analysis of an ideal system. The optimum condenser pressure for actual systems is obtained for different gas extraction system efficiencies. Economic considerations, however, are only qualitatively addressed.

53083 (EPRI-ER—513) **Preliminary design of axial flow hydrocarbon turbine/generator set for geothermal applications. Final report.** Samurin, N.A.; Shields, J.R. (Elliott Co., Jeannette, PA (USA)). May 1979. 185p. P 09/MF A01.

The design of a 65 MW (e) gross turbine generator set in which a hydrocarbon gas mixture is used as the motive fluid is outlined. The turbine generator set is part of a geothermal binary cycle electric power plant proposed for the Heber site in the Imperial Valley, California. Aerodynamic design considerations and estimated unit performance for three hydrocarbon gas mixtures are presented. Real gas properties and equations of state are reviewed as they affect the turbine design and the thermodynamic cycle. The mechanical designs for the casing, rotor dynamics, shaft sealing and unit construction are detailed. Support systems such as the lube and seal supply system, turbine controls, etc., are reviewed. An extensive hydrocarbon turbine general specification is also included.

GEOTHERMAL ENGINEERING

DRILLING TECHNOLOGY AND WELL HARDWARE

REFER ALSO TO CITATION(S) 53067, 53068, 53069

53084 (BNL—51013) **Cementing of geothermal wells. Progress report No. 11, October-December 1978.** Steinberg, M.; Kukacka, L.E. (Brookhaven National Lab., Upton, NY (USA)). Jun 1979. Contract EY-76-C-02-0016. 159p. P 08/MF A01.

In a one month shake-down test at East Mesa, 32 cement formulations were exposed to flowing brine at 150°C and 95 psig.

Based upon the results from this test, 15 formulations were selected for evaluation in a 2 year test. Experimental work indicates that none of the cements under consideration cause severe corrosion to steel casing. Compared with the possible corrosive attack on the steel casing by the geothermal environment, the corrosive effects of the cement are minimal. A promising cementing composition has been sent to the National Bureau of Standards for additional tests, and at least one more composition will be submitted. Pumpability tests performed on hydrothermal cements indicate several formulations that are pumpable for at least 2 hr at 316°C. Polymer concrete samples containing 50 wt% styrene - 35 wt% acrylonitrile - 5 wt% acrylamide - 10 wt% divinyl benzene have not shown any reduction in strength after exposure to 25% brine at 240°C for 8 months. This is the highest strength formulation to date and is the first formulation that has not exhibited any strength reduction after brine exposure. Strengths of 204 MPa and 162 MPa were measured at 20° and 150°C, respectively, after 8 months in brine.

53085 (IDO—1546-T1) **Support research for development of improved geothermal drill bits. Semi-annual report.** Hendrickson, R.R.; Jones, A.H.; Green, S.J.; Winzenried, R.W. (Terra Tek, Inc., Salt Lake City, UT (USA)). Dec 1977. Contract EY-76-C-07-1546. 68p. P 22/MF A01.

Progress is summarized on: material selection, fabrication and testing of MK-II bits; and seal and lubrication evaluation. Candidate steel and carbide properties were evaluated in laboratory tests before final sclections were made for the MK-II bit. The sealed bit program covers extensive testing of conventional elastomeric seals, experimental elastomeric seals, and experimental heterogeneous seals, as well as lubricant tests using a specially constructed test machine. (MHR)

53086 (IDO—1546-T2) **Support research for development of improved geothermal drill bits. Annual report.** Hendrickson, R.R.; Winzenried, R.W.; Jones, A.H.; Green, S.J. (Terra Tek, Inc., Salt Lake City, UT (USA)). Jul 1978. Contract EY-76-C-07-1546. 91p. P 05/MF A01.

Work is summarized on material selection, fabrication, and testing of Mk-III bits and seal and lubricant evaluation. (MHR)

53087 (IDO—1581-T1) **Program for the improvement of downhole drilling motor bearings and seals. Phase II, final report.** Black, A.D.; DeLafosse, P.H.; Wilson, J.G.; Tibbitts, G.A.; Green, S.J.; Nixon, J.D. (Terra Tek, Inc., Salt Lake City, UT (USA)). May 1978. Contract EG-76-C-07-1581. 112p. P 06/MF A01.

Progress in the following areas is summarized: seal testing and evaluation, bearing-seal package testing and evaluation, and lubricant testing and evaluation. (MHR)

53088 (LA-UR—79-1908) **Geothermal turbodrill field tests.** Maurer, W.C.; McDonald, W.J.; Neudecker, J.W.; Rowley, J.C.; Carwile, C. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 4p. (CONF-790906—19). P 02/MF A01.

From Geothermal Resources Council annual meeting; Reno, NV, USA (24 Sep 1979).

A new advanced geothermal turbodrill designed to operate at temperatures in excess of 500°F has been field tested in LASL's EE-2 hot, dry rock well. The operating characteristics of 5-3/8- and 7-3/4-in. turbodrills were measured on a dynamometer test stand, and then these tools were used to drill Texas Pink granite in the laboratory at rates in excess of 50 ft/hr. This compares to 10 ft/hr with conventional bits. A 7-3/4-in. turbodrill was then used to drill a 57 ft interval in granodiorite at LASL's Fenton Hill Hot Dry Rock geothermal site with a 12-1/4-in. insert roller bit. The turbodrill drilled at an average rate of 23 ft/hr compared to 10 ft/hr for conventional bits operated at 60 rpm. Plans are being made to use these turbodrills in the directional portions of LASL's hot-dry rock geothermal wells.

53089 (NVO—194(Rev.1)) **Geopressured - geothermal drilling and testing plan. Pleasant Bayou No. 2 Well, Brazoria County, Texas.** (Department of Energy, Las Vegas, NV (USA). Nevada Operations Office). Apr 1979. 104p. P 06/MF A01.

As a result of the resource assessment studies, the Brazoria fairway, located in Brazoria County, Texas, was determined to be an optimum area for additional studies. The drilling, completion, and testing of one geopressured-geothermal well (i.e., GCO-DOE Pleasant Bayou No. 1) and two disposal wells in Brazoria County were contracted. Pleasant Bayou No. 1 was spudded on July 2, 1978. Drilling proceeded and on November 17, 1978, a depth of 15,675 feet had been reached. Unstable hole conditions resulted in the pipe becoming stuck while attempting to cut core number 10. A series of hole problems, including bridges, well kicks, stuck pipe, formation breakdowns, and erosion casing at some places in the intermediate, forced the plugging back of Pleasant Bayou No. 1 to the bottom of the 13 3/8-inch casing at approximately 8,400 feet. This hole will be used as one of the two planned disposal wells. This revised plan describes moving the rig 500 feet southwest of the Pleasant Bayou No. 1 and drilling the offset Pleasant Bayou No. 2, using the same program objectives as was established for Pleasant Bayou No. 1.

53090 (SAN—1093-T3) **Hawaii Geothermal Project. Well completion report: HGP-A.** (Kingston, Reynolds, Thom and Allardice Ltd., Auckland (New Zealand)). Sep 1976. Contract EY-76-C-03-1093. 51p. P 04/MF A01.

Procedures followed and equipment used in completion of the well to 6,455 feet are described. (MHR)

53091 (SAND—79-1195) **Report of the workshop on advanced geothermal drilling and completion systems.** Varnado, S.G. (ed.). (Sandia Labs., Albuquerque, NM (USA)). Jun 1979. Contract EY-76-C-04-0789. 94p. P 05/MF A01.

The discussions, conclusions, and recommendations of the Workshop on Advanced Geothermal Drilling and Completion Systems are summarized. The purpose of the workshop was to identify new drilling and completion systems that have the potential for significantly reducing the cost of geothermal wells, and to provide recommendations as to the research and development tasks that are required to develop these advanced systems. Participants in the workshop included representatives from private industry, universities, and government who were organized into four working groups as follows: Rock Drilling Technology, Surface Technology, Borehole Technology, and Directional Drilling Technology. The Panel on Rock Drilling Technology was charged with identifying advanced concepts for breaking rock that could result in instantaneous penetration rates three to five times higher than those of conventional rotary drilling. The Panel on Surface Technology discussed improvements in surface equipment and operating procedures that could contribute to reduced well costs. The Panel on Borehole Technology discussed problems associated with establishing and maintaining a stable borehole for the long-term production of geothermal wells. The Panel on Directional Drilling Technology addressed problems encountered in drilling deviated wells in geothermal reservoirs.

53092 (SAND—79-1342C) **Aqueous foams for geothermal drilling fluids. I. Surfactant screening.** Rand, P.B. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 4p. (CONF-790906—2). P 02/MF A01.

From Geothermal Resources Council annual meeting; Reno, NV, USA (24 Sep 1979).

Aqueous foam is a promising drilling fluid for geothermal wells because it will not harm the producing formation and would eliminate the erosion problems of air drilling. Successful use of aqueous foam will require a high foaming surfactant which will: (1) be chemically stable in the harsh thermal and chemical environment, and (2) form stable foams at high temperatures and pressures. This paper presents the procedures developed to generate and test aqueous foams and the effects of a 260°C temperature cycle on aqueous surfactant solutions. More than fifty selected surfactants were evaluated, with representatives from the amphoteric, anionic, cationic, and nonionic classes included. Most surfactants were severely degraded by this temperature cycle; however, some showed excellent retention of their properties. The most promising surfactant types were the alkyl and alkyl aryl sulfonates and the ethoxylated nonionics.

53093 (SAND—79-1344) **Magma Energy Research, 79-1. Semi-annual report, October 1, 1978-March 31, 1979.** Traeger, R.K.; Colp, J.L.; Neel, R.R. (eds.). (Sandia Labs., Albuquerque, NM (USA)). Jul 1979. Contract EY-76-C-04-0789. 59p. P 04/MF A01.

A major effort in evaluating Kilauea Iki lava lake has been completed. The physical model based on FY 76 geophysical experiments is not correct in that a low viscosity, liquid lens of appreciable thickness does not exist. Mathematical models of the cooling of the lava lake and the state of solidification of the liquid lens were verified by thermal profile and permeability measurements. New jet-augmented drilling concepts successfully penetrated the viscous, multi-phase molten rock region in some locations where conventional drilling failed. Heat transfer studies in the lake suggest injection of fluids to enhance convection may be useful to extract energy from magma chamber margins. Other activities resulted in the completion and successful testing of a 800 cc simulation facility for evaluating simulated magma properties at temperatures to 1500°C and pressures to 4 kbar. In materials compatibility studies, thermodynamic stability diagrams were developed for 15 pure metals in basaltic magma systems and compatibility tests completed. Results are being used to define simple alloy systems which may be compatible with magmas and to identify other superalloy materials candidates.

CORROSION, SCALING, AND MATERIALS DEVELOPMENT

REFER ALSO TO CITATION(S) 53084

53094 (BNL—25957) **Concrete polymer materials as alternate materials of construction for geothermal applications - field test evalu-**

ations. Fontana, J.J.; Zeldin, A. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 22p. (CONF-790219—11). P 02/MF A01.

From AIME annual meeting; New Orleans, LA, USA (18 Feb 1979).

A serious problem in the development of geothermal energy is the availability of durable and economical materials of construction for handling hot brine and steam. Hot brine and other aerated geothermal fluids are highly corrosive and they attack most conventional materials of construction. Brookhaven National Laboratory has been investigating the use of concrete polymer materials as alternate materials of construction for geothermal processes. To date, successful field tests have been demonstrated at the Geysers, US Bureau of Mines Corrosion Facility, and at the East Mesa Geothermal Facility. This is a survey of field and laboratory evaluations of concrete polymer materials which have been shown to be durable and economical as alternate materials of construction.

53095 (DGE—1026-2) **Development and evaluation of elastomeric materials for geothermal applications. Annual report, October 1977-December 1978.** Mueller, W.A.; Kalfayan, S.H.; Reilly, W.W.; Yavrouian, A.H.; Mosesman, I.D.; Ingham, J.D. (Jet Propulsion Lab., Pasadena, CA (USA)). 15 May 1979. Contract EX-76-A-31-1026; EY-76-S-03-1086. 50p. P 03/MF A01.

The research involved formulation of commercially available materials and synthesis of new elastomers. Formulation studies at JPL and elsewhere produced a material having about 250-350 psi tensile strength and 30 to 80% elongation at 260°C for at least 24 hours in simulated brine. The relationship between these laboratory test results and sealing performance in actual or simulated test conditions is not entirely clear; however, it is believed that no conventional formation or casing packer design is likely to perform well using these materials. The synthetic effort focused on high temperature block copolymers and development of curable polystyrene. Procedures were worked out for synthesizing these new materials. Initial results with heat-cured unfilled polystyrene gum at 260°C indicated a tensile strength of about 50 psi. Cast films of the first sample of polyphenyl quinoxaline-polystyrene block copolymer, which has a graft-block structure consisting of a polystyrene chain with pendant polyphenyl quinoxaline groups, showed elastomeric behavior in the required temperature range. Its tensile strength and elongation at 260°C were 220 to 350 psi and 18 to 36%, respectively. All of these materials also showed satisfactory hydrolytic stability. A procedure for the synthesis of a linear block copolymer of this type has been devised, and the required new intermediates have been synthesized and characterized. A description of the previous year's work is included in an appendix.

53096 (UCID—18238) **On-line tests of organic additives for the inhibition of the precipitation of silica from hypersaline geothermal brine III. Scaling measurements and tests of other methods of brine modification.** Harrar, J.E.; Locke, F.E.; Otto, C.H. Jr.; Lorensen, L.E.; Frey, W.P.; Snell, E.O. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Aug 1979. Contract W-7405-ENG-48. 33p. P 03/MF A01.

The Lawrence Livermore Laboratory Brine Treatment Test System at Niland, Imperial Valley, California, has been used to evaluate a promising organic compound to the abatement of siliceous scale in brine handling equipment. Three-day scaling tests of Ethoquad 18/25 (Armak) alone (at a concentration of 25 ppM), and Ethoquad in combination with Dequest 2060 (Monsanto) showed a scaling rate reduction of 40 to 80% at 90°C, 15 to 40% at 125°C, and no reduction of 210°C. Changes in the salinity of the brine during the test series were found to have a pronounced effect on the rates of precipitation of silia and scaling, and on the effectiveness of the Ethoquad as an inhibitor. Additional data are reported on the reduction of scale by acidification with hydrochloric acid, and some of the effects of producing acidified brine by the addition of hydrogen peroxide were measured. The influence of brine salinity and pH (altered with sodium hydroxide) on the distribution of monomeric silica in the flash system was examined. Several new compounds were tested as silica precipitation inhibitors and one, PAE HCl [Dynapol poly(aminoethylene, HCl salt)], was found to be the most potent yet discovered. Proposals for future studies are outlined.

GEOTHERMAL RESERVOIR AND WELL PERFORMANCE

REFER ALSO TO CITATION(S) 53058, 53089

53097 (CONF-790906—23) **Evaluation of testing and reservoir parameters in geothermal wells at Raft River and Boise, Idaho.** Allman, D.W.; Goldman, D.; Niemi, W.L. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 4p. P 02/MF A01.

From Geothermal Resources Council annual meeting; Reno, NV, USA (24 Sep 1979).

Evaluating the Raft River and Boise, Idaho, resources by pump and injection tests requires information on the geology, geochemistry, surficial and borehole geophysics, and well construction and development methods. Nonideal test conditions and a complex hydrogeologic system prevent the use of idealized mathematical models for data evaluation in a one-phase fluid system. An empirical approach is successfully used since it was observed that all valid pump and injection well pressure data for constant discharge tests plotted as linear trends on semilogarithmic plots of borehole pressure versus time since pumping or injection began. Quantification of the pressure response prior to 600 minutes is not always possible. Short-duration (< 24-hour) injection or pump tests are conducted with the drilling rig equipment, and long-duration (21-day) injection and pump tests are then conducted with the permanent pumping facilities. Replicate instrumentation for pressure, temperature, and flow rates are necessary to ensure quality data. Water quality and monitor well data are also collected.

53098 (LA-UR—79-1987) **Interwell tracer analyses of a hydraulically fractured granitic geothermal reservoir.** Tester, J.W.; Potter, R.M.; Bivins, R.L. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 16p. (CONF-790913—2). P 02/MF A01.

From 54. annual technical conference and exhibition; Las Vegas, NV, USA (23 Sep 1979).

Field experiments using fluorescent dye and radioactive tracers (Br^{82} and I^{131}) have been employed to characterize a hot, low-matrix permeability, hydraulically-fractured granitic reservoir at depths of 2440 to 2960 m (8000 to 9700 ft). Tracer profiles and residence time distributions have been used to delineate changes in the fracture system, particularly in diagnosing pathological flow patterns and in identifying new injection and production zones. The effectiveness of one- and two-dimensional theoretical dispersion models utilizing single and multiple porous, fractured zones with velocity and formation dependent effects are discussed with respect to actual field data.

53099 (LBL—8883) **Second invitational well-testing symposium proceedings.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1978. Contract W-7405-ENG-48. 148p. (CONF-7810170—). P 07/MF A01.

From 2. international well-testing symposium; Berkeley, CA, USA (25 Oct 1978).

The symposium dealt with the state of the art of injection of fluids underground, and its application to geothermal systems in particular. Separate abstracts were prepared for fourteen papers and three abstracts of papers were listed by title. Three papers were previously abstracted for EDB.

53100 (LBL—8883, pp 1-7) **Injection testing at RRGI-4 Raft River, Idaho, Idaho National Engineering Laboratory.** Niemi, W.L.; Nelson, L.B. (EG and G Idaho, Inc.). 1978.

From 2. international well-testing symposium; Berkeley, CA, USA (25 Oct 1978).

Injection testing of a 866 m (2840 ft) deep well, RRGI-4, within the Raft River KGRA began in March and concluded in June 1978. The purpose of the testing was to determine the hydrogeologic characteristics of an intermediate zone above and adjacent to the primary geothermal producing zone(s) and to ascertain the feasibility of injecting cold, unaerated water into a zone hydraulically connected to the producing zone(s). The results and conclusions drawn from the longest duration test, conducted between May 30 and June 9, 1978, of the testing program are discussed.

53101 (LBL—8883, pp 8-14) **Injection test for Brady's Hot Springs, Nevada.** Rudisill, J.M.; Dykstra, H. 1978.

From 2. international well-testing symposium; Berkeley, CA, USA (25 Oct 1978).

An evaluation of the resource at Brady's Hot Springs, Nevada included a determination of the suitability of existing wells in the field for the disposal or injection of produced fluids. This evaluation consisted of the following: the determination of the suitability of existing wells as injection or disposal wells; the design of an injection test for the most promising of the investigated candidate wells; and performance of the injection test. The data obtained in the field was analyzed and interpreted to determine the well's suitability as an injector. The conclusion of the test was that none of the wells were suitable as an injector because of pressure interference with the producer and the subsequent concern of a short time thermal breakthrough to the producer.

53102 (LBL—8883, pp 15-28) **Extraction—reinjection at Ahuachapan geothermal field.** Cuellar, G.; Choussy, M.; Escobar, D. (Comision Ejecutiva Hidroelectrica del Rio Lempa, San Salvador, El Salvador). 1978.

From 2. international well-testing symposium; Berkeley, CA, USA (25 Oct 1978).

A review of the geology and thermodynamics of the Ahuachapan Geothermal Field is given. The intensive mass extraction of the steam—water mixture started after the first unit began operating. The total mass extraction until August 1978 reached 50,478 kilotons. A continuous program of measurements was made in order to obtain

a complete history of pressures, temperatures, and chemistry changes of the reservoir fluids as a result of the controlled extraction—reinjection system.

53103 (LBL—8883, pp 34-40) **Results of two injection tests at the East Mesa KGRA.** McEdwards, D.G.; Benson, S.M. (Lawrence Berkeley Lab., CA). 1978.

From 2. international well-testing symposium; Berkeley, CA, USA (25 Oct 1978).

Two injection tests were performed on two wells in the East Mesa KGRA. These wells were Republic Geothermal Well 18-28 and Bureau of Reclamation Well 5-1. The average reservoir temperature in the completion intervals (1500 to 2700 meters) of the existing wells is approximately 180°C. The injection tests were carried out to determine the ability of these wells to dispose of the spent brine that is produced from the existing production wells. Well 18-28 was monitored continuously for four months with a Hewlett-Packard downhole pressure and temperature gauge. Three separate injection episodes were monitored. The first two were each four-day tests with step changes in the injection rate. The third injection period lasted approximately 40 days and also included step rate changes. Well 5-1 downhole pressure response during injection was monitored for five days using a silicon oil filled capillary tube connected to a paro-scientific pressure transducer. The injection rate schedule consisted of 6 step changes. The reservoir parameters (kh/μ, phi chre^2) obtained from the analysis of transient pressure data and the skin values associated with the indivdual wells are discussed. The quality of the data obtained using a silicon oil-filled capillary tube in a cold injection well is also discussed.

53104 (LBL—8883, pp 47-57) **Numerical modeling studies in well test analysis.** Tsang, C.F.; Zerzan, M.; Bodvarsson, G.; Lippmann, M.; Mangold, D.; Narasimhan, T.N.; Pruess, K.; Schroeder, R. (Univ. of California, Berkeley). 1978.

From 2. international well-testing symposium; Berkeley, CA, USA (25 Oct 1978).

Conventional well test analysis methods are commonly applied to well data from geothermal fields despite the isothermal assumptions of these techniques. A series of studies in which numerical models are used to investigate the effects seen at a well producing from or injecting into a heterogeneous, non-isothermal system are reported. The numerical models used for these studies are briefly discussed. The description of and results from different cases studied using these models and implications for the analysis of geothermal well data in light of these results are also presented.

53105 (LBL—8883, pp 58) **Recent developments in well test analysis for fractured wells.** Cinco-Ley, H. (Stanford Univ., CA). 1978.

From 2. international well-testing symposium; Berkeley, CA, USA (25 Oct 1978).

53106 (LBL—8883, pp 71-77) **Fluid flow in naturally fractured reservoirs.** Streltsova-Adams, T.D. (Rice Univ., Houston, TX). 1978.

From 2. international well-testing symposium; Berkeley, CA, USA (25 Oct 1978).

Analysis of fluid flow in naturally fractured reservoirs is discussed. Field records of pressure behavior in fracture formations reveal a variety of reservoir responses. These include the bending of the pressure curve type, the specified initial slope type, the homogeneous reservoir type, the two-asymptotic lines types, the reverse distance-drawdown type, etc. The characteristic behavior of fractured formations in not readily recognized and the divergence in interpreting the fracture flow behavior is well known. An apparent diversity of the fractured reservoir performance is discussed here by analyzing the characteristic pressure response of a double porosity model. A general approach for developing a fluid flow model is considered first. The pressure drawdown is presented then for two constituents of a double porosity media - fractures and matrix. The solution for the fracture flow is an alternative to that given by Warren and Root (1963). A conclusion is reached that a unique interpretation of the diversive response of a naturally fractured reservoir requires independent information that adequately specifies the reservoir properties.

53107 (LBL—8883, pp 95-107) **Example of fluid migration between the layers on the Cerro Prieto Geothermal Field.** Mercado, S.; Samaniego, F. (Instituto de Investigaciones Electricas, Cuernavaca, Mexico). 1978.

From 2. international well-testing symposium; Berkeley, CA, USA (25 Oct 1978).

A field example is shown of fluid migration between the layers of the Cerro Prieto Geothermal Field. The first part presents results for well M-15. Measurements of the Na/K index are used to demonstrate the mixing of relatively warm water of the upper layer with the hotter water of the lower layer. The second part shows results for well M-21 and its replacement M-21A, completed at the upper layer.

53108 (LBL—8883, pp 112-120) **Response of pressure changes in a fluid filled capillary tube.** Miller, C.W.; Haney, J. (Lawrence Berkeley Lab., CA). 1978.

From 2. international well-testing symposium; Berkeley, CA, USA (25 Oct 1978).

An analysis was done on the transmission of a pressure change through a fluid filled capillary tube. The effects of viscosity (μ), compressibility (C/sub t/), and temperature changes with time (∂ T/∂ t) on the signal propagation were investigated. For small disturbances (less than 1% of the bulk modulus), the propagation of the pressure signal, P, was characterized by a diffusion like equation. For large disturbances, compressibility effects are more important and a wavelike equation with damping results. An experiment was run to test the numerical model and excellent agreement was found. Recommendations were made as to the best operation of the tool.

53109 (LBL—8883, pp 122-131) **Effect of thermal dispersion on injection of hot water in aquifers.** Sauty, J.P. (Bureau de Recherches Geologiques et Minieres, Orleans, France); Gringarten, A.C.; Landel, P.A. 1978.

From 2. international well-testing symposium; Berkeley, CA, USA (25 Oct 1978).

Two series of experiments on hot water injection, storage and recovery have been performed in France in 1976 and 1977. Analysis of temperature profiles in the aquifer and temperature spot measurement in the caprock provided detailed knowledge of the thermal behavior of the reservoir. The 1976 data were used to calibrate a numerical model that was then able to accurately predict the results of the second series of experiments performed in 1977. The results give strong evidence of th existance of heat dispersion during injection and recovery opertions with a resulting apparent thermal conductivity in the aquifer much higher than the one measured usually by conventional methods. This phenomenon is important for predicting the efficiency of heat storage or low temperature geothermal projects and cannot be neglected.

53110 **Reinjection program in the Ahuachapan geothermal field.** Cuellar, G. (Comision Ejectutiva Hidroelectrica del Rio Lempa, Soyapango, El Salvador). pp 571-584 of International symposium on geothermal energy in Latin America. Rome, Italy; Instituto Italo-Latinoamericano (1977). (In Spanish)

From Geothermal conference; Guatemala City, Guatemala (18 Oct 1976).

Approximately 12.7% of the total of the fluids extracted has been reinjected into the Ahuachapan geothermal reservoir and, in the short term, a reinjection capacity of the order of 60 to 70% is assumed. The components of the reinjection system, the relations between the zones of high permeability and thermal capacity, and the variations of pressure with reinjection volume are presented.

RESERVOIR STIMULATION AND EXTRACTION TECHNOLOGY

REFER ALSO TO CITATION(S) 53056

53111 (RLO—2336-1) **High-temperature explosive development for geothermal well stimulation. Final report.** Schmidt, E.W.; Mars, J.E.; Wang, C. (Rocket Research Corp., Redmond, WA (USA)). 31 Mar 1978. Contract EY-76-C-06-2336. 225p. (RRC—78-R-586). P 10/MF A01.

A two-component, temperature-resistant liquid explosive called HITEX has been developed which is capable of withstanding 561°K (550°F) for 24 hours in a geothermal environment. The explosive is intended for the stimulation of nonproducing or marginally producing geothermal (hot dry rock, vapor-dominated or hydrothermal) reservoirs by fracturing the strata in the vicinity of a borehole. The explosive is inherently safe because it is mixed below ground downhole from two nondetonable liquid components. Development and safety tests included differential scanning calorimetry, thermal stability, minerals compatibility, drop-weight sensitivity, adiabatic compression, electrostatic discharge sensitivity, friction sensitivity, detonation arrest capability, cook-off tests, detonability at ambient and elevated pressure, detonation velocity and thin film propagation in a wedge.

DIRECT ENERGY UTILIZATION

53112 (NMEI—10-1) **District space heating potential of low temperature hydrothermal geothermal resources in the southwestern United States. Technical report.** McDevitt, P.K.; Rao, C.R. (New Mexico Univ., Albuquerque (USA). Dept. of Economics; New Mexico State Univ., Las Cruces (USA). New Mexico Energy Inst.). Oct 1978. Contract EC-77-S-04-3992. 72p. P 04/MF A01.

A computer simulation model (GIRORA-Nonelectric) is developed to study the economics of district space heating using geothermal energy. GIRORA-Nonelectric is a discounted cashflow

investment model which evaluates the financial return on investment for space heating. This model consists of two major submodels: the exploration for and development of a geothermal anomaly by a geothermal producer, and the purchase of geothermal fluid by a district heating unit. The primary output of the model is a calculated rate of return on investment earned by the geothermal producer. The results of the sensitivity analysis of the model subject to changes in physical and economic parameters are given in this report. Using the results of the economic analysis and technological screening criteria, all the low temperature geothermal sites in Southwestern United States are examined for economic viability for space heating application. The methodology adopted and the results are given.

53113 (TREE—1370) **Raft River Geothermal Aquaculture Experiment. Phase II.** Campbell, D.K.; Rose, F.L.; Kent, J.C.; Watson, L.R.; Sullivan, J.F. (Idaho National Engineering Lab., Idaho Falls (USA)). Aug 1979. Contract EY-76-C-07-1570. 30p. P 03/MF A01.

Channel catfish, tilapia and Malaysian prawns were cultured directly in geothermal water for approximately seven months at the Department of Energy, Raft River Geothermal Site, to evaluate the organisms throughout a grow-out cycle. Parameters evaluated included survival, growth, bioaccumulation of metals and fluoride, collagen synthesis, and bone calcium levels. Growth at Raft River was slightly lower than at a companion commercial facility at Buhl, Idaho, but was attributed to facility differences rather than an adverse impact of geothermal water. No significant differences were recorded between Raft River and Buhl fish for bone calcium or collagen concentrations. No significant accumulation of heavy metals by fish or prawns was recorded.

53114 (SAN—1316-5) **Additional studies of geothermal district heating for Mammoth Lakes Village, California. Final report, October 1977—March 1978.** Sims, A.V.; Racine, W.C. (Holt (Ben) Co., Pasadena, CA (USA)). [nd]. Contract EY-76-C-03-1316. 39p. P 03/MF A01.

A field survey of three heating uses: snow melting, jacuzzi pool heating, and swimming pool heating in Mammoth was undertaken. Based on the results, monthly heating capacity factors were calculated and rough designs were prepared for hydronic district heating for each system. Capital cost estimates were prepared for snow melting, jacuzzi pool heating and swimming pool heating systems using LPG and geothermal district heating. It was determined that incorporation of the three additional heating uses in the District Heating System previously defined would require a capacity increase from 52 MWt to 60 MWt to meet peak demands. Energy sales would increase by about 40 percent to 127 million kwh(t) per year. The unit cost for delivered heat at 1977 price levels would decrease from 4.26 cents to 3.22 cents/kwh(t) for an investor owned District Heating System, or from 2.89 cents to 2.24 cents/kwh(t) for public ownership. The total heating costs, including annual costs of customer's heating equipment for a typical building in the Village with district heating, were compared with costs to heat the same building with electricity. The total annual costs for snow melting, jacuzzi heating and swimming pool heating using a 60 MWt District Heating System were compared with costs to heat with LPG. It was determined that 11 permits must be obtained prior to beginning construction of the District Heating System. A project schedule outlining regulatory, engineering, design, construction and operation activities for the District Heating System was prepared.

TIDAL POWER

WAVE ENERGY CONVERTERS

53115 **Utilization of wave power at a coastal site.** Henderson, G.; Donald, K.J.; Webber, N.B. (Univ of Southampton, Engl). *Proc. Inst. Civ. Eng. (London);* **67**: 1-11(Mar 1979).

The power potential was examined at a coastal site in Poole Bay in the United Kingdom, where a waverider buoy has been maintained for four years and where there is a serious coast protection problem. The harnessing of wave energy was studied.

WIND ENERGY

REFER ALSO TO CITATION(S) 52745, 53353

53116 (CONF-7804121—(Absts.), pp 19) **Consumer owned wind turbine systems.** Eggleston, D.M. (Univ. of Texas, Odessa). 1978.

From International solar energy conference and fair; El Paso, TX, USA (13 Apr 1978).

AVAILABILITY (CLIMATOLOGY)

REFER ALSO TO CITATION(S) 53127

53117 (CONF-790665—2) **Application of power laws for wind energy assessment.** Sisterson, D.L.; Hicks, B.B. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 8p. P 02/MF A01.

From American Meterological Society; Portland, OR, USA (19 Jun 1979).

From the ANL data, the frequency distribution of the power-law exponent based on actual wind profiles has been assessed hourly, seasonally, and annually. These data show that p values exceed 0.4 (indicative of decoupled conditions when wind maxima occur) on 50% of summer nights and 15% of winter nights. Wind energy estimates from actual wind data at 50 m are shown to be underestimated by 40% when derived from lower level winds by use of a 1/7 power law. These results are expected to be similar for the relatively flat farmlands of the Midwest and Great Plains. However, the stresses caused by unusually large wind shears on the blades of large wind machines in these areas will be greater than anticipated, as the blades rotate in and out of layers of faster moving air during the stable, nighttime hours. A nomogram of wind shear versus size of large wind machine blades is presented, based on power-law wind profiles.

53118 (UCID—18232) **Oahu surface wind network. Summary of data, August 1976—July 1978.** Shinn, J.H.; Sherman, C.A.; Walton, J.J.; Hill, K.L.; Clegg, B.R.; Whisler, D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jun 1979. Contract W-7405-ENG-48. 486p. P 21/MF A01.

A twenty-one station network of surface wind observations on Oahu, Hawaii, provides an extensive data base for characterization of mesoscale phenomena. These data are available in hourly averages of wind speed and direction beginning in August 1976, and are summarized here by means of an audit and statistics. The audit shows the amount of data available from each station, and the statistics provided are the average day (diurnal trend) and deviation, the monthly trends of daily means, the wind speed duration curve, the Weibull distribution fit and a frequency of occurrence histogram. (Detailed hourly data are available in listings.)

53119 **Prince Edward Island Wind Energy Program.** Lodge, M. (Inst. of Man and Resources, Charlottetown, Prince Edward Island). pp 4.3.5.1-4.3.5.13 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

This paper describes the Wind Energy Program of the Institute of Man and Resources. Work on this program commenced in June of 1977. The Wind Energy Program is composed of four sub-programs. The first sub-program is an analysis of six years of historical wind data available from eight monitoring sites operated for the Atmospheric Environment Service (A.E.S.) of Canada by the P.E.I. Department of Agriculture. Subsequently, spatial correlation of data from pairs of these sites is performed. As well, data from three additional sites established and operated by the IMR are being correlated with A.E.S. data to establish a prediction model which may be used to predict the available wind power at a chosen site from short term observation at that site. Results of the data analysis are presented. The second and third sub-programs are to assess the integration of large WECS with the P.E.I. electric utility system and the application of small machines for rural and non-electric end uses respectively. A preliminary description of the application of a Darrieus VAWT for direct heat generation for space heating of a greenhouse and residence is given. Preliminary objectives and description of the Atlantic Wind Test Site are outlined.

ECONOMICS

53120 (SAND—78-0962(vol.1)) **Economic analysis of Darrieus vertical axis wind turbine systems for the generation of utility grid electrical power. Volume I. Executive summary.** Sullivan, W.N. (Sandia Labs., Albuquerque, NM (USA)). Aug 1979. Contract EY-76-C-04-0789. 28p. P 03/MF A01.

The economic analysis of the Darrieus vertical axis wind turbine is contained in four separate volumes. This first volume summarizes the complete study, presenting a description of the technical approach used, key results, and major conclusions.

53121 (SAND—78-0962(vol.2)) **Economic analysis of Darrieus vertical axis wind turbine systems for the generation of utility grid electrical power. Volume II. Economic optimization model.** Sullivan, W.N. (Sandia Labs., Albuquerque, NM (USA)). Aug 1979. Contract EY-76-C-04-0789. 100p. P 05/MF A01.

This report is part of a four-volume study of Darrieus vertical axis wind turbine (VAWT) economics. This volume describes a computer model of VAWT cost and performance factors useful for system design and optimization. The content and limitations of the model are outlined. Output data are presented to demonstrate selection of optima and to indicate sensitivity of energy cost to design parameter variations. Optimized specifications generated by this model for six point designs are summarized. These designs subsequently receive a detailed economic analysis discussed in Volume IV. An appendix is included with a FORTRAN IV listing of the model and a description of the input/output characteristics.

53122 Reliability of distributed wind generators. Kahn, E. (Univ of Calif, Lawrence Berkeley Lab). *Electr. Power Syst. Res.;* **2**: No. 1, 1-14(Mar 1979).

This paper explores the data and models necessary to evaluate the reliability of wind generators that are geographically distributed in a utility system. A case study is conducted using California data. Results on capacity credit are found to depend upon the size of the region, the reliability of the wind regime, the existing power system generator mix, and the penetration of the wind generators.

WIND ENERGY ENGINEERING

TURBINE DESIGN AND OPERATION

REFER ALSO TO CITATION(S) 53119

53123 (CONF-7804121—(Absts.), pp 20) **Development and test of small wind energy conversion systems (SWECS).** Healy, T.J. (Rockwell International, Golden, CO). 1978.

From International solar energy conference and fair; El Paso, TX, USA (13 Apr 1978).

53124 (DOE/NASA/0002—79/1) **MOD-2 failure mode and effects analysis.** Lynette, R.; Poore, R. (Boeing Engineering and Construction Co., Seattle, WA (USA)). Jul 1979. Contract EX-76-A-29-1022. 325p. (NASA-CR—159632). P 14/MF A01.

The failure mode and effects analyses (FMEA) were performed during preliminary and detail design in order to identify all MOD-2 failure modes and to ensure that the resultant effects are: (1) acceptable from a safety standpoint and (2) fail safe or, if not fail safe, represent least cost solutions (i.e., result in the lowest cost of electricity). The FMEA's were completed by the cognizant designers and reviewed by system engineers and a reliability specialist. In general, fail safe design is employed wherever cost effective and a safe life design is employed for single thread structural items such as the rotor. The failure severity code used in the analysis is described.

53125 (PNL—2530) **Gust-rise exceedance statistics for wind turbine design.** Huang, C.H.; Fichtl, G.H. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jul 1979. Contract EY-76-C-06-1830. 36p. P 03/MF A01.

When designing a wind machine, the number of large amplitude gusts for the design-life exposure of a wind machine should be estimated, because velocity change controls the acceleration rate of a rotor. Since the record length of data is insufficient, the theoretical study of gust rise may shed some light on the empirical formulation in which some important parameters may have been ignored. Fichtl developed an equation based on Rice's theory (1944, 1945), which estimates the total number of crossings with positive slope per unit of time that exceeds a prescribed level of velocity change. The analytical representation of Fichtl's formulation is presented, and useful results of the velocity change for the design life of a wind energy conversion system (WECS) are included.

53126 Wind power from a vortex chamber. Wang, P.N.; Huang, I. (National Tsing Hua Univ., Hsinchu, Taiwan). pp 4.3.1.1-4.3.1.9 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

To study the wind power through a tornado type vortex flow, a spiral shape vortex chamber was tested in an open circuit, suction type wind tunnel. The vortex chamber was placed on the floor of the tunnel with the central region of the chamber bottom connected out of the wind tunnel to a blower. With the prevailing wind speed, blowing flow rate, central opening area and height of the chamber as control parameters, the wind power characteristics can be studied. The wind power W is defined as $W = (-\Delta p) \cdot Q$, where $(-\Delta p)$ is the pressure difference between a reference point in the upstream and the center point of the chamber opening, and Q is the blowing rate through the central region of the chamber. The important experimental results are as follows: (1) for small Q, W is drastically increased as prevailing wind speed increases; (2) W is increased exponentially after Q passes a critical value (the critical value of Q is highly dependent on prevailing wind speed); (3) for larger Q, W is decreased as the opening area and height of chamber increase; and (4) the maximum power coefficient C/sub p/ in this experiment is 14.

53127 NRC's Wind Energy Program. Rangi, R.S.; South, P.; Templin, R.J. (National Research Council, Ottawa, Ontario). pp 4.3.2.1-4.3.2.15 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

This paper describes current work on wind power assessment and on the Vertical Axis Wind Turbines at the National Research Council (NRC) Ottawa. A map showing the annual average wind power density is presented. The electrical wind power potential for all of Canada and individual provinces has been calculated from the wind power density. The wind power potential is also assessed for: (a) all land area, (b) existing electrical network +300 km, and (c) existing electrical network +150 km. The theoretical and development work on the VAWT and also the demonstration projects that are sponsored by National Research Council are described. In particular, the preliminary performance data from the 200 kW Magdalen Island unit is included.

53128 Hybrid wind turbine suitable for developing regions. Bilgen, E.; Paraschivoiu, I.; Kaine, M. (Ecole Polytechnique, Montreal, Quebec). pp 4.3.3.1-4.3.3.6 of Renewable alternatives. Volume 2. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

In this article, a study is presented on a hybrid wind turbine which consists of two vertical axis coaxial turbines, one of Savonius type and the other a screw type. The Savonius type turbine rotates in a uniform velocity field while the second, the screw type, converts the kinetic energy of the vortex flow generated in the center of the first turbine. Theoretically, it is shown earlier that the total efficiency of such a hybrid wind turbine can have a higher efficiency compared to that obtained from a simple system and the simplicity of the Savonius for manufacturing and maintenance of the system is retained. A model has been built to study the overall performance of this system, the results of which will serve to design and build a prototype hybrid turbine for the northern regions of Quebec.

ELECTRIC POWER ENGINEERING

REFER ALSO TO CITATION(S) 53349, 53352

POWER PLANTS AND POWER GENERATION

REFER ALSO TO CITATION(S) 52448

53129 (FE—2455-27) **Conceptual design of an AFBC electric power generating plant. Final report. Volume I. Executive summary.** Kimel, E.; Panico, S.; Bianchini, J.; Novack, M.; Armstrong, J.; Wysocki, J. (Burns and Roe, Inc., Woodbury, NY (USA)). Feb 1979. Contract ET-77-C-01-2455. 118p. P 06/MF A01.

Economic analyses were conducted to determine the mid-1978 generation costs and resulting cost of electricity (COE) for a base case AFBC plant, incorporating all the applicable and economically justifiable improvements resulting from the design study programs, and a comparable, base case, pulverized coal-fired (PCF) plant utilizing a FGD system. In addition, economic sensitivity analyses were conducted in order to determine the COE for AFBC and PCF plant configurations corresponding to a plant extension and a boiler conversion of an existing oil-fired plant. Additional economic sensitivity analyses considered the effect of varying the SO_2 emission level on base case AFBC and PCF plant economics and the effect of varying the superficial fluidizing velocity on AFBC base case plant economics. All AFBC plant economic analyses are based on CE's modified design, which is presented in Appendix A of Volume III of this report. This modified design includes an improved main bed cyclone, with a particulate collection efficiency of 95% and a corresponding carbon collection efficiency of 99% (an increase from the 90% particulate and 90% carbon collection efficiencies selected in the previous design), and confirmation of the optimum high temperature steam in bed tube configuration, the 12 ft/sec superficial fluidizing velocity, and the uniformity of the feed splitter flow distribution.

53130 (PB—291331) **Orbes Phase I: interim findings. Summary report, August 1976-August 1977.** Stukel, J.J.; Keenan, B. (Illinois Univ., Urbana (USA)). Nov 1977. 172p. Y A08/MF A01.

This report is an integrated summary of various elements of Phase I of the Ohio River Basin Energy Study (ORBES) which

includes three parallel but independent preliminary technology assessments and a number of in-depth topical studies. ORBES Phase I was conducted by research faculty from six state universities in the state comprising the Phase I study region: all of Kentucky, and substantial portions of Illinois, Indiana and Ohio. The results reported are preliminary in nature and reflect limitations in data availability and analysis which were found. Four alternative scenarios for energy development in the region through the year 2000 were employed to conduct the analysis. Some of the major preliminary fundings of this first year assessment are: (1) air quality limitations in the region are becoming increasingly important considerations; (2) water availability limitations may become important before the year 2000; and (3) a high rate of growth may be associated with an insufficiency of skilled labor to construct conversion facilities. The implications of these and other selected findings for public policy development are discussed.

COOLING AND HEAT TRANSFER EQUIPMENT AND SYSTEMS

53131 (COO—4196-3, pp XII.1-XII.5) **Basis for fuel and utility costs.** Kramek, R. (Carnegie-Mellon Univ., Pittsburgh, PA). Sep 1978.

In Energy conservation in coal conversion. Final report, September 15, 1977—September 1, 1978. Selected case studies and conservation methodologies.

All the reports in COO-4196-3 use a common basis for fuel and utility costs presented in Table 1. The costs for electricity, natural gas, distillate fuel oil, residual fuel oil, LPG, and coal have been excerpted from the FEA energy price projections, and are for FEA region V, which encompasses the design location of the Oil/Gas Complex designed by Ralph M. Parsons Co. The costs for cooling water and steam are averaged figures quoted in reference 2. The distillate fuels in Table 1 comprise light and middle fuel oil derivatives such as kerosene and diesel fuel, and include no's 1, 2, 3, 4 fuel oil. The residual fuels are no's 5, 6, Bunker C and all other petroleum fuels which have a fifty per cent boiling point over 700°F. All costs are in 1977 dollars.

53132 (COO—4531-3) **Effect of alternate cooling systems and beneficial use of waste heat on power plant performance.** Rao, D.K.; Porter, R.W. (Illinois Inst. of Tech., Chicago (USA). Dept. of Mechanical Engineering). Nov 1978. Contract EC-77-S-02-4531. 123p. P 06/MF A01.

The performance and cost of alternate closed-cycle cooling systems for steam—electric power plants are discussed. Included are cooling ponds, spray canals and mechanical- and natural-draft wet cooling towers. Besides equipment, operational and maintenance costs, loss of generating capacity is determined on a seasonal basis in order to determine life-cycle costs relative to once-through cooling. In addition, two beneficial uses of waste heat are similarly analyzed: once-through discharge of condenser coolant into a municipal water supply and interaction of a conventional cooling system with a wastewater treatment plant. Both typical nuclear- and fossil-fueled power plants are considered throughout. Meteorological and system parameters were taken for the Chicago area as an example. Plant heat rates, availability and unit costs were selected from the literature. A new unified analysis of closed-cycle-cooling system performance is developed in order to facilitate computation of loss of generating capacity. The order of cooling systems in terms of increasing cost is: once-through, pond, natural-draft wet tower, spray canal and mechanical-draft wet tower. Alternatively, once-through discharge into a municipal water supply would save 1 to 2% of power-plant fuel and 14 to 22% of residential water-heater energy. Or, the interactive wastewater plant would save 2 to 15% of treatment costs, favoring larger facilities.

POWER CYCLES

REFER ALSO TO CITATION(S) 52442, 52874

53133 (AED-CONF—77-565-007) **State of the art of combined gas/steam turbine power plants with upstream coal pressure gasification plant by the STEAG-Lurgi system.** Meyer-Kahrweg, H. (STEAG Anlagentechnik, Essen (Germany, F.R.)). 1977. 26p. (In German). (CONF-771261—10). U 03/MF A01.

From Conference on coal gasification and hydrogenation; Essen, F.R. Germany (7 Dec 1977).

This report describes the 170 MW coal pressure gasification power plant at Zuenen, progress in coal pressure gasification, and the development of the KDV-400 gas, steam turbine, and boiler plant.

53134 (COO—4196-3, pp VII.1-VII.26) **Combined cycle in-plant electrical power generation. A case study.** Mueller, E.J. (Carnegie-Mellon Univ., Pittsburgh, PA). Sep 1978.

In Energy conservation in coal conversion. Final report, September 15, 1977—September 1, 1978. Selected case studies and conservation methodologies.

A combined cycle power generation scheme for the Ralph Parsons Oil/Gas plant was studied as an alternate to the steam turbine power generation system to see if energy can be saved in a cost effective way. Using the same amount of coal as the present system it generates an excess of 22.2 megawatts of electrical power or 10.6% of the 210 MW generated in the Oil/Gas Complex at a cost of $610/KW. If electricity is exported at $.025/KW-hr the annual gross revenues are 4.3 million dollars a year. This is a 19% return on investment, using a discounted cash flow analysis. From a life cycle cost stand point, this is a total revenue of 56.5 million dollars over the 20-year life of the plant. The combined cycle alternate, which uses present state-of-the-art equipment, is a cost effective way to better utilize energy.

53135 (COO—4196-3, pp X.i-X.xvi, 1.1-6.8) **Case study: The thermodynamic performance of two combined cycle power plants integrated with two coal gasification systems.** Stasa, F.L.; Osterle, J.F. (Carnegie-Mellon Univ., Pittsburgh, PA). Sep 1978.

In Energy conservation in coal conversion. Final report, September 15, 1977—September 1, 1978. Selected case studies and conservation methodologies.

Thermodynamic models of both an adiabatic and an endothermic coal gasifier integrated with either a waste heat combined cycle or a supercharged boiler combined cycle are developed and incorporated into a Fortran computer program. The adiabatic gasification process requires air and steam, while the endothermic gasification process requires only steam. The former produces a low-Btu power gas, and the latter an intermediate-Btu power gas. Most of the sulfur in the coal is removed after the gasification step in the form of hydrogen sulfide. The resulting relatively clean power gas fires the combined cycle which is composed of an open Brayton cycle and a superheated regenerative Rankine cycle without reheat. Each configuration is optimized with respect to components and certain key operating parameters, with and without consideration of the power plant emission standards established by the federal government through the EPA. With a gas turbine inlet temperature of 2000°F and with consideration of the pollution criteria, the configuration employing an adiabatic gasifier and a waste heat system is marginally the best with a station efficiency of only 37 percent. The success of power generation schemes utilizing integrated gasification and combined cycles appears to be dependent on an increased gas turbine inlet temperature; for a 400°F increase, the station efficiency improves by 5 percentage points.

53136 (DOE/NASA/1062—79/1) **Benefits of advanced technology in industrial cogeneration.** Barna, G.J.; Burns, R.K. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1979. Contract EC-77-A-31-1062. 29p. (NASA-TM—79160; CONF-790493—2). P 03/MF A01.

From Electric Power Research Institute cogeneration workshop; San Antonio, TX, USA (1 Apr 1979).

Cogeneration in a wide variety of representative industrial plant applications is being examined including plants selected from the most energy consuming US industries; namely the chemical, primary metals, petroleum refining, paper, stone clay and glass, and food industries. Emphasis in the study is on the use of coal or coal-derived fuels.

53137 (EPRI-FP—995) **Cost estimate of fluidized bed combustor air heater for gas turbines. Final report.** Schaefer, R. (Curtiss-Wright Corp., Wood-Ridge, NJ (USA)). Feb 1979. 56p. P 04/MF A01.

This program consisted of a study of the performance, design concept and capital cost of an unconventional coal-burning, gas turbine, electric power generation system including an indirect-fired air heater in the form of a pressurized fluidized bed (PFB) operating near stoichiometric fuel/air ratios. The system has two special features. One is the use in a turbine of clean air heated by the PFB to produce most of the electrical energy of the system. The other is the use of reduced temperature combustion gases from the PFB in an expander which has been used in industrial applications having similar erosive environment. Various cycles were evaluated, and one was selected for conceptual design and cost estimates. Indications of system reliability and factors to be resolved by research and development are presented. Capital cost of the system per installed kilowatt is higher than for the base design PFB system by about 20%. This base design PFB being developed for the Department of Energy (DOE), does not use a clean air turbine/dirty gas expander as studied here and has a higher bed operating temperature. The higher cost is due primarily to the separate compressor-expander-generator equipment associated with the combustion air system and to the additional number of gas turbine modules to provide the same power plant rating with a reduced turbine inlet temperature. Based on current fuel price levels, the power generation cost with this system is 20% higher than with the base PFB system and 28% lower than with oil-fired conventional boiler systems.

53138 (FE—2357-44) **CFCC development program. Quarterly report, April-June 1978.** (General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.). Nov 1978. Contract EX-76-C-01-2357. 33p. P 03/MF A01.

A formal Design Review of the Commercial Plant Baseline Design was conducted. At this stage in the development of the Coal-Fired, Combined-Cycle concept, it was generally agreed by the review team that the GE program team has defined a reference plant configuration suitable for potential expansion to the definitive design of a pilot plant. The testing of shrouded hot gas ducting at a size and temperature of the CFCC configuration has been completed. The results of these tests indicate that the transfer line design is believed to be suitable for the CFCC conditions, and on this basis, Foster Wheeler is willing to provide commercial offerings at the CFCC conditions. Small burner rig simulation testing continues. PFB-5PM and PFB-6PM, after 5400 hours of simulated exposure in the burner rig are still in good condition. Over 5000 hours of small burner rig testing has been completed. The results, thus far, indicate high aluminum CoCrAlY claddings possess superior corrosion resistance in the 1600°F environment. Activated diffusion bonding of MS5001 blade tips has proved successful, and the mechanical property evaluation of selected claddings continues. Cold flow testing of the Developmental Cyclone has been completed. The implementation of increased disengagement length and outlet skimming (2 1/2% of flow) led to approximately 60% reduction in outlet dust loading relative to Stairmand high efficiency device.

53139 (FE—2612-25) **Advanced coal fueled combustor/heat exchanger technology study. Quarterly technical progress report No. 5, October-December 1978.** Campbell, J. Jr. (Rockwell International Corp., Canoga Park, CA (USA). Rocketdyne Div.). 1978. Contract EF-77-C-01-2612. 79p. P 05/MF A01.

This effort constitutes the first phase of what is expected to be a three-phase program to advance coal fueled combustor/heat exchanger technology. The technology would be utilized in conjunction with high temperature closed cycle gas turbine, (CCGT), power conversion systems. The present effort consists entirely of studies, analysis, design, and reporting. No fabrication or test effort is involved. This 1977—1978 effort was concerned with CCGT cycles and heat exchangers appropriate for a 350 MWe unit size central station application. A contract extension was granted to Rockwell International to provide additional effort to establish relevant CCGT system designs, particularly primary heater designs, suitable for smaller generating systems providing both electric power in the 25 to 50 MWe range and useful process heat. Such systems would be expected to find application in cogeneration service in large industrial plants, or in district heating applications, etc., where the simultaneous demand for both process heat and electrical power permits added economies in fuel utilization.

53140 (MTR—7973) **High temperature turbine technology: summary of four integrated gasification and overall plant design descriptions.** Larson, J.W.; Boyum, W.B.; Lewis, J.P. (Mitre Corp., McLean, VA (USA)). Sep 1978. Contract EX-76-C-01-2453. 184p. P 09/MF A01.

Four industrial gas turbine manufacturers were contracted by the US Department of Energy to perform Phase I, Program and System Definition, of the High Tempeture Turbine Technology Program. Each contractor prepared an Overall Plant Design Description of a combined cycle power plant with integrated coal gasification. These combined cycles employed a primary cycle gas turbine with firing temperatures in the range of 2600°F to 3000°F through the use of advanced turbine combustors and turbine blade cooling techniques. Conventional steam plant technology was applied in the bottoming cycle whih together with the primary cycle gas turbine showed promise for coal pile to bus bar thermal efficiencies ranging from 40 to 47%. These plants are described, and the material and energy balances are presented.

53141 (RI/RD—78-212A) **Advanced coal-fueled combustor/heat exchanger technology study. Final report, March 1977—June 1978.** (Rockwell International Corp., Canoga Park, CA (USA). Rocketdyne Div.). 1978. Contract EF-77-C-01-2612. 331p. P 15/MF A01.

This report is concerned principally with the design of coal-fired combustor/heat exchangers suitable for inputting the heat to base-loaded, closed-cycle, gas turbine, 350 MWe, central station power generation systems. A wide variety of CCGT cycles are evaluated to establish the performance requirements for the combustor/heat exchanger. The cycles finally selected for combustor/heat exchanger design operate at 1550, 1750, and 2250 F maximum working-fluid temperatures. At the 1550 F maximum working-fluid temperature, two combustor/heat exchanger preliminary designs are created, one utilizing the pulverized-coal-fired, dry-bottom furnace firing concept and the other utilizing the atmospheric-pressure, fluidized bed with limestone addition firing concept. In both designs, all heat exchanger surface is metal. At the 1750 F maximum working-fluid temperature, the combustor/heat exchanger preliminary design is based on a series arrangement of high- and low-temperature fluidized beds. At 2250 F maximum working-fluid temperature, the combustor/heat exchanger preliminary design is based on the slagging cyclone combustor concept. Heat exchanger surface exposed to working-fluid temperatures above 1550 F in the last two designs is constructed of silicon carbide. The key technical features of the four preliminary designs are identified and analyzed. Research and development programs to advance the technology of these designs to a state of readiness for commercial application are outlined, and R and D cost estimates are presented. The cost of electricity produced in 700 MWe stations incorporating the studied CCGT cycles and combustor/heat exchangers is estimated and compared with the cost of electricity in conventional steam stations.

53142 **Steam at work: industrial and marine steam plant.** New York, NY; Mechanical Engineering Publications Limited (1977). 156p. (CONF-7705137—).

From Conference on steam at work: industrial and marine steam plant; Manadon, Plymouth, UK (10 May 1977).

A separate abstract was prepared for 13 of the papers presented at the conference. The remaining 5 papers were not in scope for the data base. (MCW)

COMPONENTS

REFER ALSO TO CITATION(S) 53140

53143 (FE—2357-24) **CFCC Development Program. Annual progress report, July 1976—June 1977.** (General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.). Sep 1978. Contract EX-76-C-01-2357. 225p. P 10/MF A01.

During the first year of the CFCC development program substantial progress was made in establishing a commercial plant concept. The overall approach to the commercial plant design evaluation with supporting technology tasks has been defined. Reliability studies and evaluation of alternate plant designs were conducted in parallel with the design activity. An environmental assessment was also conducted in parallel with the design activity. The test results have confirmed the basic assumptions on heat transfer and several configurations using the same basic tube bundle that have been evaluated. The hot gases generated in the combustor steam generator must be subsequently cleaned up, i.e., a high percentage of particulate matter removed in the hot gas clean-up system, before they are expanded in the gas turbine. The initial emphasis in the hot gas clean-up effort was to compile existing efflux data and analyze it to develop an efflux characterization. A second step is then to determine the particulate removal capabilities of existing clean-up devices as a function of particle size distribution. The basic corrosion problem in the gas turbine and in the combustor steam generator arises from the chemical species in the gas stream from a fluid bed combustor. An analytical effort is in progress to better define these various species, the parameters which effect their generation and deposition, and an assessment of their quantities and states at the time that they reach the first stage of the gas turbine.

53144 (STU—76-4014) **System engineering analysis of the steam turbine machinery (dynamics, control, reliability).** Meiri, O. (Chalmers Tekniska Hoegskola, Goeteborg (Sweden). Institutionen foer Energiteknik). Oct 1978. 43p. (In Swedish). (STU—75-3459). U 03/MF A01.

System engineering studies of the steam turbine machinery must include dynamical calculations (so called simultion) of the system, investigations of its control system and an analysis of its reliability. The details of the models for the boiler, the fuel-air system and the boiler feed water system make it possible to test different regulating strategies. Other subsystems such as stand by and the alarm system have been tested together with the control systems. Control and supervisory systems have been programmed for microprocessors which together form a high reliability system. As a by-product a simulator for training of working staff has been obtained.

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 53132

ECONOMICS

REFER ALSO TO CITATION(S) 53137, 53332

53145 (EPA—600/7-77-130, pp 17-25) **Economics and technology of coal utilization.** Balzhiser, R.E.; Spencer, D.F. Aug 1978.

From Conference on coal cleaning - an option for increased coal utilization; Arlington, VA, USA (24 May 1977).

Direct-fired low-sulfur coal comes in with the lowest busbar power cost for both baseload and intermediate operation: 25 to 28 mills/kWh and 36 to 41 mills/kWh, respectively. Nor is it unexpected that high coal costs tend to favor options with lower heat rates - generally, the combined-cycle plants. But the most telling conclusion of the study, to date, intimately related to projected emission standards and foreseeable needs for sulfur removal, is that direct firing

with wet alkali scrubbing, a technology almost fully developed today, is the second most attractive baseload option, at 28 to 34 mills/kWh with high-sulfur coal. Other findings are: (1) busbar power costs for baseload operation are in the 25 to 40-mill range, except for Lurgi low-Btu gas and petroleum-type liquids fueling conventional steam plants; (2) regenerative scrubbers, advanced gasifiers (beyond the Lurgi), and atmospheric fluidized-bed combustors are all comparable for use with conventional steam plants - and only slightly more expensive than plants with wet alkali scrubbing - for either baseload or intermediate duty; (3) only the combined-cycle versions of advanced gasification processes show promise of being less costly than low-sulfur coal; (4) combined-cycle plants using petroleum-type fuels and medium-Btu gas from advanced gasifiers have comparable costs for intermediate service; (5) atmospheric fludized-bed combustion looks attractive in baseload operation, but there is significant uncertainty in its economic performance. The payoff from this study is not the economic benefit that any utility can get by adopting the winning coal technology. The payoff is in the better shaping of R and D emphasis in EPRI's direct coal utilization and coal conversion programs. Six examples suggest the ramifications. (LTN)

OFF-PEAK ENERGY STORAGE

REFER ALSO TO CITATION(S) 53257

FUELS

REFER ALSO TO CITATION(S) 52447

53146 (COO—4196-3, pp VIII.1-VIII.28) **Direct coal fired steam generation in lieu of low Btu gas.** Cingle, G.C. III. (Carnegie-Mellon Univ., Pittsburgh, PA). Sep 1978.

In Energy conservation in coal conversion. Final report, September 15, 1977—September 1, 1978. Selected case studies and conservation methodologies.

This report examines the feasibility of replacing the low Btu gas fired steam and power generating system in the Ralph M. Parsons Oil/Gas Complex with a direct coal fired steam and power generating system. The difference in capital cost between the coal fired alternate system and the fuel gas fired system is 36.4 million dollars. For a savings in coal of 586 TPD which is 1.6% of 36,000 TPD used by the Oil/Gas Complex or 6.1 million dollars annually, the rate of return on the additional capital investment is 8.21%.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 53273

53147 (PB—291236) **Environmental assessment of coal- and oil-firing in a controlled industrial boiler. volume iii. comprehensive assessment and appendices. Final report may 77-jul 78.** Leavitt, C.; Arledge, K.; Shih, C.; Orsini, R.; Hamersma, W. (TRW, Inc., Redondo Beach, CA (USA)). Aug 1978. Contract EPA-68-02-2613. 326p. Y A15/MF A01.

A comparative assessment of coal and oil firing in a controlled industrial boiler was conducted. The comprehensive emissions assessments for each fuel were used to develop a comparative emissions assessment. On the basis of the emissions assessment a comparative environmental assessment was developed. The report consists of three volumes. This volume, Volume III, contains the comprehensive assessments and appendices and includes detailed descriptions of the test site, the test protocol, and a detailed presentation of data.

NOXIOUS GAS AND PARTICULATE ABATEMENT AND CONTROL

REFER ALSO TO CITATION(S) 52429, 52433, 52496, 52514

53148 (CONF-790634—2) **Energy and economic impacts of pollution control equipment for coal-fired power plants: an assessment model.** Farber, P.S.; Livengood, C.D. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 17p. P 02/MF A01.

From 72. annual Air Pollution Control Association meeting; Cincinnati, OH, USA (24 Jun 1979).

Substantial progress has been made in developing the data bases and models necessary for comparative assessments of environmental control technologies. Emphasis in our program has thus far been on basic coal data and postcombustion cleanup technologies. Ongoing efforts are expected to refine the existing capabilities and add models dealing with other parts of the coal-to-energy system as well as advanced control technologies.

SITE SELECTION AND LAND USE

53149 (FEA/G—77/060) **Preliminary survey of some major factors bearing on the feasibility of energy centers in Michigan.** (Federal Energy Administration, Washington, DC (USA)). Mar 1977. Contract EM-75-C-01-8476. 297p. P 13/MF A01.

Development of the energy center concept is a response to the Nation's energy supply problem that is specifically considered in this study. First, an energy center is defined in a manner judged to best meet the needs of the Great Lakes States and the State of Michigan, in particular. The basic goals of energy center development are discussed and the general characteristics of the State of Michigan are described as they relate to attaining these goals. Following this definition of energy center objectives, specific projections of future electric power demand are presented to indicate the magnitude of the problem. Using a future compounded annual growth rate of 5%, a total of 23,125 MWe would be added to the center by the year 2000 to meet demand (8 coal-fired units totaling 6225 MWe and 13 nuclear units totaling 16,900 MWe). The remainder of the major part of the study is devoted to a description of major energy center components and the features designed to supply the required energy in electric and other forms and at the same time to minimize environmental and social damage. Other features discussed include: a colocated industrial center; a biocomplex for one proposed site; port facilities; and a city of 200,000 to house center employees and servicing employees.

POWER TRANSMISSION AND DISTRIBUTION

REFER ALSO TO CITATION(S) 52804, 52808, 53273, 53347, 53751

53150 (DOE/ET/2099—T1(Vol.2)) **Factors affecting the potential of direct load control for non-generating utilities. Final report.** (Gilbert/Commonwealth, Jackson, MI (USA)). Apr 1979. Contract EX-76-C-01-2099. 468p. P 20/MF A01.

Three appendices are presented to a report (Vol. I) on a methodology for assessng the feasibility of direct load control in the environment of a non-generating electric utility. The first appendix deals with load control simulations for two urban and two rural service areas with winter or summer peak-demand seasons. The second appendix contains abstracts and data on significant water heater or central air conditioning load control tests and research programs. The final appendix discusses the operation and applicability of load control devices designed for installation at the customer's location. (LCL)

AC SYSTEMS, EHV AND UHV

53151 (EPRI-EL—1065(Vol.1)) **Cost components of high-capacity transmission options. Volume I. Final report.** Broad, R.J.; Doocy, E.S.; Bowers, F.M.; Smith, D.R.; Robottom, R.K. II; Shah, K.R.; Torri, J.F. (Commonwealth Associates, Inc., Jackson, MI (USA)). May 1979. 453p. P 20/MF A01.

The cost of various high-capacity transmission options were investigated. The intent was to determine the in-place component costs for transmission systems to be installed in the 1985 to 1990 time frame. The rationale behind developing the costs on a component basis is to allow the reader to make design and cost component changes that fit specific conditions, thereby providing a method of estimating the cost of transmission facilities. For this study, the following common design criteria assumptions were established so that each system was evaluated on the same basis: all systems are built in the northern Midwest of the United States, construction techniques and labor costs are based on that area's practices, and each system is designed for that environment; costs are developed for transmission systems capable of transmitting power at 2250 to 2500 MVA and 4500 to 5000 MVA for three distances - 5 urban mils, 50 suburban miles, and 200 rural miles; each system terminates at a 345 kV bus, substation costs necessary to transform the voltage to this level are included; and the design practices, including the levels of electrical effects, represent current design philosophy. The specific transmission systems reported in Volume I are: ac overhead EVH/UHV lines (500, 765, and 1100 kV); and dc overhead lines +-400, +-800, and +-1200 kV. The study identified those systems with relatively high economic potential. Major cost components of specific transmission systems were identified to highlight areas where further research may bring about cost reduction.

53152 (EPRI-EL—1065(Vol.2)) **Cost components of high-capacity transmission options. Volume 2. Final report.** Broad, R.J.; Doocy, E.S.; Bowers, F.M.; Smith, D.R.; Robottom, R.K. II; Shah, K.R.; Torri, J.F. (Commonwealth Associates, Inc., Jackson, MI (USA)). May 1979. 238p. Dep. NTIS, PC A11/MF A01.

Investigation into the cost of various high-capacity transmission options is reported. The intent was to determine the in-place component costs for transmission systems to be installed in the 1985

to 1990 time frame. The rationale behind developing the costs on a component basis is to allow the reader to make design and cost component changes that fit specific conditions, thereby providing a method of estimating the cost of transmission facilities. For this study, the following common design criteria assumptions were established so that each system was evaluated on the same basis: all systems are built in the northern Midwest of the U.S.; construction techniques and labor costs are based on that area's practices and each system is designed for that environment; costs are developed for transmission systems capable of transmitting power at 2250 to 2500 MVA and 4500 to 5000 MVA for three distances: 5 urban miles, 50 suburban miles, and 200 rural miles; each system terminates at a 345 kV bus; substation costs necessary to transform the voltage to this level are included; and the design practices, including the levels of electrical effects, represent current design philosophy. The specific transmission systems considered in Volume 2 are: pipe-type cables (500 kV); SF_6 transmission systems (rigid and flexible); 345 kV ac superconducting systems; 500 kV dc superconducting systems; and dc transmission systems using conventional cables. The study identified those systems with relatively high economic potential. Major cost components of specific transmission systems were identified to highlight areas where further research may bring about cost reduction.

DC SYSTEMS

REFER ALSO TO CITATION(S) 53151, 53152

53153 (COO—5014-9) **Assessment of research directions for high voltage direct current power systems. Quarterly technical progress report, April 1, 1979-June 30, 1979.** Long, W.F. (Wisconsin Univ., Madison (USA)). Aug 1979. Contract ET-78-S-02-5014. 11p. P 02/MF A01.

This is an interim report covering hvdc circuit breaker development and recommended directions for research. It is a work-in-progress; for instance, the section entitled existing dc circuit breakers is being prepared by a graduate student under support from this project. Comments from key individuals are summarized. A brief outline of objectives and tasks for two projects concludes this report.

SUPERCONDUCTING AND CRYOGENIC SYSTEMS

REFER ALSO TO CITATION(S) 53152

53154 (CONS—3015-T2) **Superconducting fault current limiter. Third quarterly technical progress report, February 8, 1979-May 7, 1979.** Eaton, R. III. (Gould-Brown Boveri, Spring House, PA (USA)). 1979. Contract ET-78-C-01-3015. 13p. P 02/MF A01.

During the first two quarters of this program considerable effort was invested in determining performance objectives for superconducting fault current limiters (SCFCL) and deciding what would be the best design concept for a SCFCL device. This third quarter has been a period of starting new long-range programs based on the decisions made in the earlier quarters. Because of the long-term nature of these studies, there are no specific results yet to report. An investigation is now in progress to determine whether there is an advantage to using SCFCLs with superconducting generators and transformers. SCFCL performance objectives specifically for these applications will be established. A detailed device analysis of the magnetically-switched, resistive SCFCL has been started. The objective of this analysis will be to determine a complete device design, including size, shape, material and operating characteristics, for a typical set of performance specifications. An experimental facility is now being prepared to make key measurements of switching and thermal recovery speeds for the magnetically-switched, resistive concept.

53155 (CONS—3015-T3) **Superconducting fault current limiter. Second quarterly technical progress report, November 8, 1978-February 7, 1979.** Eaton, R. III. (Gould-Brown Boveri, Spring House, PA (USA)). 1979. Contract ET-78-C-01-3015. 109p. P 06/MF A01.

This study has three basic objectives: to determine the performance characteristics of superconducting fault current limiter (SCFCL's) from analyses of electric power systems; to evaluate the comparative advantages and disadvantages of the various classes of SCFCL devices; and to carry out key experiments which will determine the feasibility of the most promising type of SCFCL. During this quarter, significant progress was made on the first two objectives, and key experiments have been identified. Progress on these three objectives is described.

NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 53284

53156 (NTISUB/E—129) **Operating units status report - licensed operating reactors. Monthly reports.** (Nuclear Regulatory Commission, Washington, DC (USA)). 1979. vp. Paper copy available on subscription, North American Continent price $120.00/year; single copy price PC$12.50; all others write for quote.

This report provides data on the operation of nuclear units and is divided into three sections. The first contains monthly highlights and statistics for commercial operating units, and errata from previously reported data; the second is a compilation of detailed information on each unit, provided by NRC Regional Offices and IE Headquarters; and the third section is an appendix containing comparative statistics of U.S. nuclear/fossil capacity, identification of nuclear power plants within regional Electric Reliability Councils, the relative status of U.S. nuclear electric production to all U.S. electric production by state, and selected Edison Electric Institute operating statistics.

53157 **LERs-an NRC operating experience data base.** Boyle, E.L. (US Nuclear Regulatory Commission, Washington, DC). *Trans. Am. Nucl. Soc., Suppl.;* **32**: No. 1, 58-60(Aug 1979).

53158 **Nuclear energy in the Federal Republic of Germany.** Heinrich, D.O. (Electricity Council, London (UK)). *Nucl. Energy;* **17**: No. 3, 163-168(Jul 1978).

The way the electricity supply in West Germany is organised is outlined. A summary is given of the development of commercial reactors, of FBRs and HTRs and of their role in present and future nuclear generating capacity. The link-up between manufacturers and companies within the industry is illustrated. Procedures for licensing of plant and the role of administrative courts in dealing with public contestations following the issues of licenses is described. Reference is made to plans for reprocessing.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, BOILING WATER COOLED

REFER ALSO TO CITATION(S) 53230, 53245, 53247

53159 (CONF-790441—8) **ANS-5.4 fission gas release model. III. Low temperature release.** Lorenz, R.A. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 10p. P 02/MF A01.

From ANS topical meeting on light water reactor fuel performance; Portland, OR, USA (29 Apr 1979).

A comittee of the American Nuclear Society, the ANS 5.4 Working Group, has formulated models for the release of fission gas from light water reactor (LWR) fuel operating at low temperature. The model for the release of stable fission gas and ^{85}Kr shows (as the data from which it was derived) that the fractional release at 30,000 to 35,000 MWd/MT should be less than 0.5% as long as the peak centerline temperature remains sufficiently low. A second model is used to calculate the release of shorter half-life isotopes that reach production-decay equilibrium.

53160 (CONF-791008—3) **Pulsed eddy current inspection system for nondestructive examination of irradiated fuel rods.** Yancey, M.E. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 8p. P 02/MF A01.

From ASNT fall conference; St Louis, MO, USA (15 Oct 1979).

An inspection system has been developed for nondestructive examination of irradiated fuel rods utilizing pulsed eddy current techniques. The system employs an encircling type pulsed eddy current transducer capable of sensing small defects located on both the inner and outer diameter fuel rod surfaces during a single scan. Pulsed eddy current point probes are used to provide fuel rod wall thikness data and an indication of radial defect location. Two linear variable differential transformers are used to provide information on fuel rod diameter variation. A microprocessor based control system is used to automatically scan fuel rods up to 4.06 meters in length at predetermined radial locations. Defects as small as 0.005 cm deep by 0.254 cm long by 0.005 cm wide have been detected on outside diameter surfaces of a 1.43 cm outside diameter fuel rod cladding with a 0.094 cm wall thickness and 0.010 cm deep by 0.254 cm long by 0.005 cm wide on the inside diameter surface.

53161 (COO—4014-13) **Dresden Unit 1: chemical cleaning. Progress report, first and second quarters 1979.** (Commonwealth Edison Co., Chicago, IL (USA)). 29 Jun 1979. Contract EY-76-C-02-4014. 7p. P 02/MF A01.

Engineering and construction activities associated with the Dresden Unit 1 chemical cleaning facility are described for January to June 1979.

53162 **BWR servicing and refueling improvement program.** Perry, D.R. (General Electric Co., San Jose, CA). *Trans. Am. Nucl. Soc., Suppl.;* **32**: No. 1, 4-5(1979).

53163 **BWR off-gas explosions.** Lo, R.H. (US Nuclear Regulatory Commission, Washington, DC). *Trans. Am. Nucl. Soc., Suppl.;* **32**: No. 1, 26(1979).

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, NON-BOILING WATER COOLED

REFER ALSO TO CITATION(S) 53159, 53160, 53211, 53230, 53239, 53240, 53243, 53247, 53250, 53424, 53579, 53943

53164 (BAW—1519) **Post-irradiation examination of Oconee 1 fuel: cycle 1 nondestructive test phase.** (Babcock and Wilcox Co., Lynchburg, VA (USA)). Jun 1979. Contract ET-78-C-02-4711. 43p. P 03/MF A01.

Standard B and W pressurized water reactor fuel was examined after one cycle of irradiation in the Oconee 1 reactor. The examination was conducted in the Oconee Units 1 and 2 spent fuel storage pool using underwater test equipment. Data obtained included spring constants, rod and assembly dimensional changes, crud analysis, and fuel column axial gap and stack lengths. Parametric changes generally were well within the design envelope. The 36 assemblies that were visually examined were structurally sound and showed no evidence of cocked grids, fretting, or visually observable rod bowing. The only exception was two isolated cases of rod defects.

53165 (BNL-NUREG—25947) **Failure analysis of tubes with wastages.** Prachuktam, S.; Reich, M.; Rajan, J. (Brookhaven National Lab., Upton, NY (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Technical Review). 1979. Contract EY-76-C-02-0016. 8p. (CONF-790615—21). P 02/MF A01.

From 3. US national congress on pressure vessels and piping; San Francisco, CA, USA (25 Jun 1979).

A finite element method for large strain calculation using the constitutive relation due to Hill was developed. This constitutive relation relates the co-rotational rate of the Kirchoff stress and deformation rate tensor which leads to a symmetric structure stiffness. This method is used to calculate failure pressures of degraded tubes.

53166 (DLCS—5000179) **[Shippingport Atomic Power Station]. Quarterly operating report, first quarter 1979.** (Duquesne Light Co., Shippingport, PA (USA)). 1979. Contract EY-76-C-11-0292. 29p. P 03/MF A01.

At the beginning of the first quarter of 1979, the Shippingport Atomic Power Station was operating with the 1A, 1B, 1C, and 1D reactor coolant loops and the 1AC and 1BD purification loops in service. The remainder of the expended PWR Core 2 was in storage under shielding water in the deep pit of the Fuel Handling Building. The 1A, 1B, 1C, and 1D 991 psig self-actuated steam relief valves remained gagged during the quarter to prevent leakage through the valve seats. Gagging of redundant relief valves is permitted by ASME Code and approved operating procedures. During the quarter, the Station was operated for Duquesne Light Company system grid including base load and swing load operation. Seven (7) swing load operations were performed on the LWBR Core this quarter to complete the LWBR operating plan of fifty (50) during this operating phase. The LWBR Core has generated 10,771.43 EFPH from startup through the end of the quarter. The generator load factor this quarter was 85%.

53167 (DLCS—5000279) **[Shippingport Atomic Power Station]. Quarterly operating report, second quarter 1979.** (Duquesne Light Co., Shippingport, PA (USA)). 1979. Contract EY-76-C-11-0292. 24p. P 02/MF A01.

At the beginning of the second quarter of 1979, the Shippingport Atomic Power Station remained shutdown for the normally planned semiannual maintenance and testing program, initiated March 23, 1979. The station was in a cooldown condition at approximately 150°F and 300 psig with a steam bubble maintained in the pressurizer and the reactor coolant pumps in slow speed. The reactor plant cooldown heat exchanger was in service to maintain coolant temperature. The 1A, 1B, 1C, and 1D reactor coolant loops and the 1AC and 1BD purification loops remained in service. The remainder of the expended PWR Core 2 was in storage under shielding water in the deep pit of the Fuel Handling Building. The 1A, 1B, 1C, and 1D 991 psig self-actuated steam relief valves remained gagged during the quarter to prevent leakage through the valve seats. Gagging of redundant relief valves is permitted by ASME Code and approved operating procedure. The LWBR Core has generated 10,771.43 EFPH from start-up through the end of the quarter.

53168 (Juel—1527) **Study on the profitability of electricity generation with high temperature reactors.** Kolb, G. (ed.). (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Programmgruppe Systemforschung und Technologische Entwicklung). Aug 1978. 97p. (In German). U 06/MF A01.

The programme group 'Systemforschung und Technologische Entwicklung' (STE) of the Nuclear Research Centre Juelich in cooperation with the internal institutions 'Projekttraegerschaft Entwicklung von Hochtemperaturreaktoren' (PTH) and 'Institut fuer Reaktorentwicklung' (IRE) on the one hand, and the external partner 'Hochtemperatur-Reactorbau GmbH' (HRB) and 'Gesellschaft fuer Hochtemperaturreactor Technik' (GHT) on the other hand have set up a study on fuel cycle cost., electricity production cost and the economical use as well as uranium resource protection by introduction of high temperature reactors (HTR) with pebble bed core to generate electricity. The pressurized-water reactor (PWR) today on the market serves as comparison. The working results obtained sofar are compiled in the present report. It was particularly noted that - the HTR can economically fully compete with the PWR for electricity generation - the necessary supply of natural uranium for the HTR in open circuit is about one third lower and in the closed circuit, almost two thirds lower than in the corresponding PWR. A further reduction is possible on a long-term basis by highly converting HTW systems.

53169 (UCID—18131) **Technical evaluation of the electrical, instrumentation, and control design aspects of the low temperature overpressure protection system for the Maine Yankee nuclear power plant.** Latorre, V.R.; Mayn, B.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.; EG and G, Inc., San Ramon, CA (USA). Energy Measurements Group). Aug 1979. Contract W-7405-ENG-48. 27p. P 03/MF A01.

This report documents the technical evaluation of the electrical, instrumentation, and control design aspects for the low temperature overpressure protection system of the Maine Yankee nuclear power plant. Design basis criteria used to evaluate the acceptability of the system included operator action, system testability, single failure criterion, and seismic Category I and IEEE Std-279-1971 criteria.

53170 (UCID—18132) **Technical evaluation of the electrical, instrumentation, and control design aspects of the low temperature overpressure protection system for the Yankee Rowe nuclear power plant.** Latorre, V.R.; Mayn, B.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.; EG and G, Inc., San Ramon, CA (USA). Energy Measurements Group). Aug 1979. Contract W-7405-ENG-48. 29p. P 03/MF A01.

This report documents the technical evaluation of the electrical, instrumentation, and control design aspects for the low temperature overpressure protection system of the Yankee Rowe nuclear power plant. Design basis criteria used to evaluate the acceptability of the system included operator action, system testability, single failure criterion, and seismic Category I and IEEE Std-279-1971 criteria.

POWER REACTORS, NON-BREEDING, GRAPHITE MODERATED

REFER ALSO TO CITATION(S) 53168, 53438, 53456

53171 (ORNL/CSD/TM—60) **Transient diffusion through a spherical shell into its finite spherical core.** Reeves, M.; Tolliver, J.S. (Oak Ridge National Lab., TN (USA)). Aug 1979. Contract W-7405-ENG-26. 32p. P 03/MF A01.

The problem of the diffusion of gas through a spherical shell into its spherical core is solved by using the Laplace transform technique. The transformed solution is obtained and then inverted to the corresponding solution in real space. This real space solution is slowly converging for small times. Therefore, an alternate expression is obtained that is appropriate and more rapidly convergent for small times. As an example, the first solution is used to calculate the theoretical gas content of the core of High-Temperature Gas-Cooled Reactor (HTGR) biso-coated fuel particles from fuel-particle batch OR2261/HT after 850°C anneals in helium.

53172 (ORNL/TM—6940) **Characterization of SiC coatings on HTGR fuel particles: preliminary report.** Lauf, R.J.; Braski, D.N.; Tennery, V.J. (Oak Ridge National Lab., TN (USA)). Aug 1979. Contract W-7405-ENG-26. 38p. P 03/MF A01.

Fuel particles for the HTGR contain a layer of pyrolytic silicon carbide to act as a pressure vessel and fission product barrier. The SiC is deposited by the thermal decomposition of methyltrichlorosilane (CH_3SiCl_3 or MTS) in an excess of hydrogen. Coatings deposited at temperatures from 1500 to 1700°C and coating

rates of 0.4 to 1.2 μm/min have been studied by optical microscopy, x-ray diffraction, electron microscopy, and density measurements. Transmission electron microscopy (TEM) has shown the microstructural features to be extremely complex and much finer than the ability of optical microscopy to resolve. X-ray diffraction has detected traces of α-SiC in some coatings, and those conditions of deposition temperature and coating rate that give rise to this phase have been determined.

POWER REACTORS, BREEDING

REFER ALSO TO CITATION(S) 53231, 53232, 53233, 53234, 53235, 53236, 53237, 53238, 53241, 53242, 53251, 53253

53173 (CONF-790572—3) **GCFR Fuels and Materials Program at Argonne National Laboratory.** Neimark, L.A.; Greenberg, S.; Johnson, C.E.; Purohit, A.; Liu, Y.Y.; Rest, J.; Reimann, K.J.; McLennan, G.A. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 19p. P 02/MF A01.

From Helium Breeder Associates/US Dept of Energy GCFR technical meeting; San Diego, CA, USA (30 May 1979).

The F-5 fuel-pin irradiation experiment in EBR-II is a cornerstone of the GCFR program. It is the largest-scale fuel-pin experiment in the present program and will provide data on the performance of pins and a pin-support structure that are prototypic of the GCFR Demonstration Plant. The fuel pins are presently undergoing interim examination after successfully achieving 4.6 at.% burnup. Studies of the thermodynamics and kinetics of the U—Cs—O system, supplemented by analysis of the results of previously irradiated fuel pins, have led to the incorporation of fuel-design modifications in the F-5 experiment to insure adequate performance of the vented fuel. The effect of ribbing, as well as the ribbing process, on the short- and long-term structural performance of fuel-pin cladding is being evaluated via in-reactor and out-of-reactor tests and with the fuel-element modeling code LIFE-GCFR and the finite element program, ADINA.

53174 (CONF-790802—44) **Test of the second model of the GCFR steam generator cavity closure plug.** Callahan, J.P.; Robinson, G.C.; Dodge, W.G. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 18p. P 02/MF A01.

From International conference on structural mechanics in reactor technology; Berlin, F.R. Germany (13 Aug 1979).

As part of its participation in the program to develop a 300 MW(e) gas-cooled fast reactor (GCFR) demonstration power plant, the Oak Ridge National Laboratory (ORNL) is conducting a series of structural model tests. One of the tasks of the ORNL effort provides for the design, analysis and/or testing of small-scale models of the PCRV penetration closure plugs. The principal objectives are to determine structural response of the plugs to normal operating pressures and to substantial overpressurization. The tests also provide reliable data for verification of analysis methods. Included in the testing program are models of both the steam generator cavity closure and central core cavity closure plugs. Thus far, two models of the steam generator cavity closure series have been tested. The first model which represented the original GA design was pressurized to 75.8 MPa (11,000 psi) without sustaining cracking of the concrete or failure of the plug although yielding of the metallic components was recorded by attached strain gages.

53175 (CONF-790816—19) **Analysis of sodium valve reliability data at CREDO.** Bott, T.F.; Haas, P.M. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 13p. P 02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

The Centralized Reliability Data Organization (CREDO) has been established at Oak Ridge National Laboratory (ORNL) by the Department of Energy to provide a centralized source of data for reliability/maintainabilty analysis of advanced reactor systems. The current schedule calls for develoment of the data system at a moderate pace, with the first major distribution of data in late FY-1980. Continuous long-term collection of engineering, operating, and event data has been initiated at EBR-II and FFTF.

53176 (CONF-790816—22) **Evaluation of COBRA III-C and SABRE-I (wire wrap version) computational results by comparison with steady-state data from a 19-pin internally guard heated sodium cooled bundle with a six-channel central blockage (THORS bundle 3C).** Dearing, J.F.; Rose, S.D.; Nelson, W.R. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 17p. P 02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

The predicted computational results of two well-known subchannel analysis codes, COBRA-III-C and SABRE-I (wire wrap version), have been evaluated by comparison with steady state temperature data from the THORS Facility at ORNL. Both codes give good predictions of transverse and axial temperatures when compared with wire wrap thermocouple data. The crossflow velocity profiles predicted by these codes are similar which is encouraging since the wire wrap models are based on different assumptions.

53177 (CONF-790816—24) **THORS: a high-temperature sodium test facility rated at 2.0 MW.** Gnadt, P.A.; Anderson, A.H.; Clapp, N.E.; Montgomery, B.H.; Collins, C.W.; Stulting, R.D. (Oak Ridge National Lab., TN (USA); Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.). 1979. Contract W-7405-ENG-26. 12p. P 02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

The Thermal—Hydraulic Out-of-Reactor Safety (THORS) facility at Oak Ridge Naitonal Laboratory (ORNL) is a high-temperature sodium test facility operated for the United States Breeder Reactor Safety Program. The facility is primarily used for testing large simulated Liquid-Metal Fast Breeder Reactor (LMFBR) fuel subassemblies. The facility has recently been upgraded to provide a 2.0-MW test bundle power input and heat removal capability. A new test section, which will be capable of operating at 980°C and which will accommodate a 217-pin bundle, has also been added. A 61-pin bundle is currently under test in the facility. A description of the test facility is presented, along with a brief summary of the 8-year operating history of this safety-related test facility.

53178 (CONF-790816—28) **Design optimization of a prototype large breeder reactor safety system.** Rasmuson, D.M.; Wilson, J.R.; Burdick, G.R. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 12p. P 02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

A procedure is presented that can be used in the conceptualization of, evaluation of, and selection among several conceptual liquid metal fast breeder reactor (LMFBR) designs. The method can be effectively used to: (a) allocate optimal component redundancy, (b) evaluate design trade-offs, and (c) help in design finalization. The procedure is applied to three diverse design options for a shutdown heat removal system. The selected configuration is analyzed for potential common cause failures.

53179 (COO—4197-T1) **Sodium ion leak detector. Quarterly technical progress report, January 1-April 1, 1978.** Hrizo, J.; Bauerle, J.E.; Witkowski, R.E. (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). 5 May 1978. Contract EN-77-C-02-4197. 9p. AT.

This program involves a basic technology development effort for the Westinghouse Sodium Ionization Detector (SID). The study consists of four task areas that will be performed over a two-year period. This effort will establish an in-situ operational testing/calibration method for the SID. It will test the performance/reliability characteristics of aged filaments and evaluate potential chemical interference effects. Quarterly and annual reports will be submitted detailing the work accomplished during the current period, problems encountered, and their resolutions.

53180 (COO—4197-T2) **Sodium ion leak detector. Quarterly technical progress report, April 1-July 1, 1978.** Hrizo, J.; Bauerle, J.E.; Witkowski, R.E. (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). 20 Jul 1978. Contract EN-77-C-02-4197. 5p. AT.

This program involves a basic technology development effort for the Westinghouse Sodium Ionization Detector (SID). The study consists of four task areas that will be performed over a two-year period. This effort will establish an in-situ operational testing/calibration method for the SID. It will test the performance/reliability characteristics of aged filaments and evaluate potential chemical interference effects. Quarterly and annual reports will be submitted detailing the work accomplished during the current period, problems encountered, and their resolutions.

53181 (COO—4197-T3) **Sodium ion leak detector. First annual technical progress report, January 1-December 31, 1977.** Hrizo, J.; Bauerle, J.E.; Witkowski, R.E. (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). 4 Jan 1978. Contract EN-77-C-02-4197. 12p. AT.

This program involves a basic technology development effort for the Westinghouse Sodium Ionization Detector (SID). The study consists of four task areas that will be performed over a two-year period. This effort will establish an in-situ operational testing/calibration method for the SID. It will test the performance/reliability characteristics of aged filaments and evaluate potential chemical interference effects. Quarterly and annual reports will be submitted detailing the work accomplished during the current period, problems encountered, and their resolutions.

53182 (ESG-DOE—13278) **Sodium Technology Program. Quarterly technical progress report, April-June 1979.** (Rockwell Interna-

tional Corp., Canoga Park, CA (USA). Energy Systems Group). 24 Aug 1979. Contract EY-76-C-03-0824-001. 13p. AT.

Progress is reported for the following LMFBR-CRBR related activities: (1) sodium removal process development, and (2) decontamination studies.

53183 (ESG-DOE—13279) **Cover gas seal components. Quarterly technical progress report, April—June 1979.** (Rockwell International Corp., Canoga Park, CA (USA)). 24 Aug 1979. Contract EY-76-C-03-0824-011. 13p. AT.

Progress is summarized in efforts to develop and demonstrate the performance of commercial and custom-designed head region cavity seals for LMFBR reactors, to develop and evaluate advanced seal concepts capable of achieving improvement in radioactive gas containment and seal temperature-life capabilities, and to establish operational safety margins for head region seals for nominal and extraordinary LMFBR plant conditions. During FY 1979, the major effort has been directed toward designing and analyzing concepts for flexing metal dynamic seals as alternate concepts to inflatable elastomer seals. In June, the program was redirected to concentrate on improving and simplifying fabrication techniques and designs of inflatable elastomer seals.

53184 (GA-A—15455) **GCFR upflow/downflow study summary report.** Menzel, H.F. (ed.). (General Atomic Co., San Diego, CA (USA)). Aug 1979. Contract EY-76-C-03-0167-061. 154p. P 08/MF A01.

During the one-year study a conceptual upflow core plant design was developed and the downflow core plant reference design updated. A comparison was made between the two plant designs in critical areas of plant performance, safety, and licensing. The results of that comparison led to the recommendation to adopt an upflow core for the GCFR plant reference design. Although additional development and design efforts are required, the potential of residual heat removal by natural circulation alone offers a decisive safety and licensing advantage.

53185 (GA-A—15512) **GCFR main helium circulator and electric drive.** Kapich, D.D.; Sterrett, C.O. (General Atomic Co., San Diego, CA (USA)). Jul 1979. Contract EY-76-C-03-0167-023. 22p. (CONF-790572—5). P 02/MF A01.

From Helium Breeder Associates/US Dept of Energy GCFR technical meeting; San Diego, CA, USA (30 May 1979).

One of the major objectives of the helium circulators for the gas-cooled fast breeder reactor (GCFR) is to achieve the highest possible operational reliability. This is no simple task considering the plant system integration requirements, auxiliary support systems, all possible transient requirements, and resulting complexity in supplying the driving power, primary coolant flow control, and lubrication and sealing. Therefore, the design of the circulator itself is highly dependent on the type of prime mover selected to drive the circulator, e.g., series turbine, parallel turbine, or electric motor. The circulator main drive has evolved from the series steam turbine drive into the variable-speed, synchronous electric motor drive mounted externally to the reactor and controlled by thyristor variable frequency controller. This design is a result of 18 months of joint effort by General Atomic Company and Westinghouse Electric Corporation.

53186 (GEFR—00366) **Interim evaluation of data from sodium-water reaction tests SWR-3, SWR-4, and SWR-5 and comparison with transwrap analyses. Series I: large-leak test program.** Regimbal, J.J.; Bradfute, J.O.; Rauch, T.; Sane, J.O. (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.). Jun 1978. Contract EY-76-C-03-0893-030. 159p. AT.

This evaluation treats the experimental results and analyses of performance of three additional sodium water reaction tests performed in the Large Leak Test Rig (LLTR) by ETEC (formerly LMEC). A series of six tests were conducted in the LLTR over the past few years. This report combines the evaluation of SWR-3, SWR-4, and SWR-5 in the continuing effort to provide a basis for validating the TRANSWRAP computer code. All three of the tests were DEG ruptures of a tube in the hockey stick region of the MSG with the same break location, 1.75 inches from the sodium face of the upper tube sheet. In SWR-3 the rupture tube was filled with a two phase mixture of steam and water; in SWR-4 the water side fluid was superheated steam and in SWR-5 nitrogen was used as the working fluid. The water side pressure was nominally 1900 psia for all three tests. These three tests, taken collectively, were intended to provide an experimental basis for an interpretation of the role of the pressurizing fluid vis-a-vis the products of the sodium/water reaction in producing the initial bubble pressure transient, since appreciably different flow rates of the liquid and vapor were delivered in SWR-3 and SWR-4 and non-reactive nitrogen was the pressurizing gas for SWR-5.

53187 (GEFR—00426-1) **Hydraulic testing program on vented assembly core design, FY-78. Volume 1: vent hydraulics testing.** Edelfelt, I.H. (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.). Jan 1979. Contract EY-76-C-03-0893-031. 22p. AT.

During FY-77 a combined theoretical and experimental program was conducted for the purpose of determining the key parameters for the vent hole design in an actual LMFBR. The theoretical work was based on the pipe break flow analysis as modeled by Quan. This analysis predicted two types of flow regimes; free jet and confined flows, with the particular classification depending upon the relative area of the vent hole to that of the channel gap. The vent area is the cross-sectional area of the vent hole, while the gap area is the area resulting by multiplying the vent perimeter by the duct-to-duct (interstitial) spacing. In the case of a small vent-hole-to-gap area ratio such that the vent flow is limited by the hole area, a free jet model was used. On the other hand, if the channel gap area is smaller than that of the vent area, a confined flow model was used. The FY-78 effort which is being reported here included two vent flow pressure drop tests, both performed with a constant 1.5-inch diameter vent size. The first consisted of rotating the test channel in the test rig by 60 degrees so that the vent holes would be opposite one another. This configuration was tested over the same range of variables as was used in the FY-77 tests. The second set of tests employed a reverse, or inflow, configuration wherein the channel was in its standard orientation with the vents not opposite one another but with flow out of the interstitial space into the tube bundle.

53188 (GEFR—00426-2) **Hydraulic testing program on vented assembly core design, FY-78. Volume 2: pin vibration testing.** Edelfelt, I.H. (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.). Jan 1979. Contract EY-76-C-03-0893-031. 224p. AT.

One problem which could conceivably exist in any reactor assembly and which, therefore, must be investigated is flow induced vibration of the fuel pins. It is to the evaluation of this possible source of trouble that the work reported here was addressed. During FY-77, a combined theoretical and experimental program was conducted for the purpose of determining the flow and pressure drop characteristics for the vent hole design in an actual LMFBR. During the 1977 program, a flow loop was constructed incorporating a test model. The fuel pin vibration study reported herein makes use of this test model and flow loop. The model consists of a single channel containing a tube bundle. Surrounding this channel was another hexagonal channel which duplicated the adjacent walls of the six channels which would normally surround any interior channel in a complete fuel assembly. The spacing between the two channels thus corresponded to the interstitial gap. A biaxial accelerometer was installed in each of eight tubes, or pins as they are referred to in an actual reactor unit; four adjacent to vents, two adjacent to nonvented walls and two near the center. In all cases, the accelerometers were located in the plane of the three vent holes. Data were recorded from the accelerometers for the no flow case, for reference purposes, and with inlet flows of 240 GPM, 320 GPM and 400 GPM with vent flow from 0 to 30% of the inlet flow. The results were processed by a Fourier analyzer to yield plots of g loading versus frequency. The resulting plots are given in this report along with a disucssion of the results.

53189 (HEDL-SA—1756-5) **Long-term in-reactor corrosion of stainless steel cladding in liquid sodium.** Jensen, B.W.; Weber, J.W.; Jost, J.W. (Hanford Engineering Development Lab., Richland, WA (USA)). 1979. Contract EY-76-C-14-2170. 6p. (CONF-790602—82(Summ.)). P 02/MF A01.

From ANS annual meeting; Atlanta, GA, USA (3 Jun 1979).

In-reactor sodium corrosion of 20% cold-worked 316 stainless steel cladding was previously reported on HEDL P-23 series mixed-oxide fuel pins exposed in EBR-II for up to 4608 hours. This report extends those studies to 11,424 hours. Data from three HEDL subassemblies, P23A, P23B, and P23C, are included in this study. Nominal sodium velocities were 1.95 m/sec, 1.83 m/sec, and 2.18 m/sec, resepectively. These 5.84 mm diameter fuel pins contained 25% PuO_2 - 75% UO_2 mixed-oxide fuel operating at a peak power of 440 W/cm. Time-averaged cladding outer surface temperature ranged from 400 to 712°C. Axial temperature gradients were approximately 960°C/m for the P23A and P23B subassemblies and 755°C/m for the P23C subassembly. Oxygen concentration in the sodium was approximately 1 ppM.

53190 (ORNL—5560) **Gas-cooled reactor programs. Annual progress report, period ending December 31, 1978.** Gat, U.; Kasten, P.R. (Oak Ridge National Lab., TN (USA)). Aug 1979. Contract W-7405-ENG-26. 241p. P 11/MF A01.

Progress is summarized in the following areas: GCFR core flow test loop, GCFR shielding and physics studies, and GCFR pressure vessel and closure studies. (JWR)

53191 (ORNL/TM—6854) **Preliminary neutronic analysis of a fast mixed-spectrum reactor (FMSR).** Burns, T.J.; White, J.R. (Oak Ridge National Lab., TN (USA)). Aug 1979. Contract W-7405-ENG-26. 43p. P 03/MF A01.

The Fast Mixed-Spectrum Reactor (FMSR) concept has been proposed as a means of alleviating certain non-proliferation concerns relating to civilian nuclear power. In particular, the concept is envisioned as operating on a natural uranium feed (after initial startup), thus eliminating the need for fuel reprocessing. The primary basis for the concept involves the production, in situ, of the fissile material required for criticality from the fertile feed material. The results of a preliminary study directed at assessing the neutronic feasibility of the concept are reported.

53192 (ORNL/TM—6996) **Preconceptual study of proliferation-resistant heterogeneous sphere-pac-fueled LMFBR cores.** Selby, D.L. (Oak Ridge National Lab., TN (USA)). Sep 1979. Contract W-7405-ENG-26. 206p. AT.

In October, 1977, a multi-institutional Proliferation-Resistant Preconceptual Core Design Study (PRPCDS) was initiated which extended to September, 1978. The objective of the study was to establish the proliferation resistance and performance potential of a wide range of sodium-cooled fast breeder reactor core designs. Each participiting organization was responsible for publishing the results from its part of the study, and this report describes ORNL's work on the Vibro-Pac fuel design concept. Special characteristics of Vibro-Pac fuel (low density, etc.) were considered in terms of effects on Doppler coefficient, fuel time constant, breeding performance, etc., in a heterogeneous core configuration. A comparison was made with a reference pellet pin design. No significant differences between Vibro-Pac and high density pellet pins were identified.

53193 (WAPD-TM—1326) **Summary of the nuclear design and performance of the Light Water Breeder Reactor (LWBR) (LWBR development program).** Hecker, H.C. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Jun 1979. Contract EY-76-C-11-0014. 168p. P 08/MF A01.

This report presents a summary of the nuclear design and expected nuclear performance of the Light Water Breeder Reactor during operation at the Shippingport Atomic Power Station. Performance predictions are presented for core lifetime, breeding margin, power distributions and performance, kinetic and stability parameters, and for core shutdown and reactivity control capability. Also included is a summary of as-built dimensions of core components and of development of breeding parameter equations and sensitivities.

53194 (WARD-OX—3045-29) **Oxide fuel element development. Quarterly progress report for period ending December 31, 1976.** Boltax, A.; Saling, J. (Westinghouse Electric Corp., Madison, PA (USA). Advanced Reactors Div.). Jun 1979. Contract EY-76-C-02-3045-007;EY-76-C-02-3045-008;EY-76-C-02-3045-009. 82p. AT.

Progress is summarized for the following tasks: coordination of mixed-oxide irradiation tests, post-irradiation examination of fast reactor experiments, evaluation and analysis of fuel and cladding irradiation behavior, radial blanket irradiation tests in EBR-2, grid type fuel assembly mechanical design, grid fabrication and tests, and fuel pin design criteria and code development.

53195 (WARD-OX—3045-31) **Oxide fuel element development. Quarterly progress report for period ending March 31, 1977.** Boltax, A.; Cooper, M.H. (Westinghouse Electric Corp., Madison, PA (USA). Advanced Reactors Div.). Jun 1979. Contract EY-76-C-02-3045-007;EY-76-C-02-3045-008;EY-76-C-02-3045-009. 125p. AT.

Progress is summarized for the following tasks: coordination of mixed-oxide irradiation tests, post-irradiation examination of fast reactor experiments, evaluation and analysis of fuel and cladding irradiation behavior, radial blanket irradiation tests in EBR-2, grid type fuel assembly mechanical design, grid fabrication and tests, and fuel pin design criteria and code development.

53196 (ANL-Trans—1174) **Primary sodium pumps of Phenix and Superphenix.** Chabassier, R.; Blateyron, J.; Guiton, P.; Canavelis, R.; Roumailhac, J.; Gravier, M. Translated from *Houille Blanche;* No. 7/8, 709-716(1977). 20p. P 02/MF A01.

This report shows how design experience at Hispano—Suiza (SNECMA Division), Bergeron SA and the French Atomic Energy Commission has determined the hydraulic and mechanical features of the primary sodium pumps for the Phenix and Superphenix reactors.

REGULATION AND LICENSING

53197 (PB—291848) **Automated personnel data base system specifications, Task V. Final report.** Bartley, H.J.; Bocast, A.K.; Deppner, F.O.; Harrison, O.J.; Kraas, I.W. (General Research Corp., McLean, VA (USA)). Nov 1978. 157p. Y A08/MF A01.

The full title of this study is 'Development of Qualification Requirements, Training Programs, Career Plans, and Methodologies for Effective Management and Training of Inspection and Enforcement Personnel.' Task V required the development of an automated personnel data base system for NRC/IE. This system is identified as the NRC/IE Personnel, Assignment, Qualifications, and Training System (PAQTS). This Task V report provides the documentation for PAQTS including the Functional Requirements Document (FRD), the Data Requirements Document (DRD), the Hardware and Software Capabilities Assessment, and the Detailed Implementation Schedule. Specific recommendations to facilitate implementation of PAQTS are also included.

ECONOMICS

REFER ALSO TO CITATION(S) 53332

FUEL CYCLE

53198 (AED-Conf—78-011-000) **Recycling of bred fissile material in the various reactor types, as seen from the point of view of reactor design.** (Kraftwerk Union A.G., Muelheim an der Ruhr (Germany, F.R.). Hauptbereich Technik). 1978. 18p. (In German). (CONF-780163—; AED-Conf—78-011-002). U 02/MF A01.

From KTG technical meeting on the recycling of fissile materials obtained in the various reactor types from the point of view of reactor design; Juelich, F.R. Germany (24 Jan 1978).

Individual papers of this conference have been abstracted.

NUCLEAR REACTOR TECHNOLOGY

THEORY AND CALCULATION

REFER ALSO TO CITATION(S) 53817

53199 (LA—7911-PR) **Transport and reactor theory. Progress report, January 1—March 31, 1979.** Dudziak, D.J.; O'Dell, R.D.; Alcouffee, R.E. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 77p. P 05/MF A01.

Research and development progress in transport and reactor theory by the Los Alamos Scientific Laboratory Group T-1 for the second quarter of FY 79 is reported. Included are tasks in the areas of Supporting Research, Reactor Safety Analysis, Fusion Reactor Nucleonics, Shielding Methods, Safeguards Analysis, and Fission Reactor Neutronics.

53200 **Correlation technique for resonance calculations.** Gregory, M.V. (E.I. du Pont de Nemours and Co., Aiken, SC). *Nucl. Sci. Eng.;* **71**: No. 1, 59-64(Jul 1979).

A correlation technique has been developed to make the accuracy of complex and long-running resonance treatments available in fast, routine calculations. The technique is based on the subgroup method and is used to generate group-averaged resonance reaction rates. By fitting the correlation to several detailed auxiliary resonance calculations, a set of weights (the Lebesgue measure) is obtained. The weights can then be applied to a wider range of new cases. Use of the correlation technique results in one-tenth the computational burden of the detailed resonance treatment, yet the results duplicate the detailed calculations to within 0.01% in k/sub eff/.

53201 **Lattice eigenvalue as a function of buckling: correction to first-order perturbation theory.** Gelbard, E.M. (Argonne National Lab., IL); Hughes, R.P. *Nucl. Sci. Eng.;* **70**: No. 3, 262-273(Jun 1979).

In earlier work by Gelbard and Lell, arguments based on perturbation theory were used to obtain relations between mean-square chord lengths and lattice eigenvalues for given bucklings. We show here that first-order perturbation theory does not give the lattice eigenvalue correctly to order B^2. When all missing terms in B^2 are inserted, the eigenvalue buckling relations remain formally unchanged, but the mean-square chord lengths must be redefined. The original and redefined mean-square chord lengths differ only insofar as events in successive fission generations are correlated. A reexamination of work based on the original relations indicates that earlier numerical results were substantially correct.

53202 (ANL-Trans—1172) **Homogenization method used for neutron calculations in fast reactors.** Bouget, Y.H.; Hammer, P.; Lyon, F. Jun 1979. Translation of Paper presented at the IAEA/NEACRP sponsored conference on Homogenization Methods in Reactors Physics, November 13—15, 1978, at Lugano, Switzerland. 24p. P 02/MF A01.

The multiplying lattices which constitute the cores of fast power reactors do not exhibit a significant heterogeneity because of the size of the fuel pins used (0 to 8 mm) and the pitch of the lattice (0 to 9 mm). The computing methods used permit a correct treat-

ment of the heterogeneities of more complex lattices constructed in critical assemblies either with rods (MASURCA) or with plates (SNEAK) and thus of transport with reduced uncertainties (+-100 pcm) of the results of integral experiments in power reactor cores. The perturbations of reactivity or distribution induced in the cores by the control rods or the presence of blankets are treated in the diffusion approximation. This approximation leads to an overestimate of the effect of the control rods (-7%) compared to the more refined but more costly transport theory. The treatment of cores by the heterogeneous concept is presently identical to that of the classical cores (of the SUPER-PHENIX type): the procedure to be used to define multigroup cross sections is the subject of studies underway. The experimental program which has been developed in MASURCA (PRERACINE program should permit optimizing the multigroup cross-section calculation method for this type of core.

COMPONENTS AND ACCESSORIES

REFER ALSO TO CITATION(S) 53132, 53425, 53437

53203 (CONF-790802—46) **Grouted and nongrouted tendons for prestressed concrete pressure vessels.** Naus, D.J. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 9p. P 02/MF A01.

From International conference on structural mechanics in reactor technology; Berlin, F.R. Germany (13 Aug 1979).

A model study was conducted under the Prestressed Concrete Pressure Vessel (PCPV) Program at the Oak Ridge National Laboratory (ORNL) to appraise grouted and nongrouted tendon systems for PCPV application. Results are presented for the experimental portion of the investigation which was conducted in four phases: (1) grouted—nongrouted tendon behavior, (2) potential new materials for PCPV applications, (3) effectiveness of organic petrolatum-based and portland cement corrosion inhibitors, and (4) acoustic emission as a technique for PCPV structural integrity monitoring.

53204 (PB—291853) **Improved ultrasonic nondestructive testing of pressure vessels. Annual progress report, 1 October 1977-30 September 1978.** Frederick, J.R.; Dixon, M.; Broek, C.V.; Papworth, D.; Elzinga, M. (Michigan Univ., Ann Arbor (USA). Dept. of Mechanical Engineering). Jan 1979. Contract NRC-04-75-182. 172p. Y A08/MF A01.

Progress in the development of a synthetic aperture focusing technique for ultrasonic pulse-echo flaw evaluation is described. The progress includes improvement in display techniques, initial results of a Spotlight-mode scanning technique, improvement in deconvolution, an assessment of the ability to identify flaw types, and an assessment of the potential for real-time synthetic-aperture processing of ultrasonic data.

53205 (RDT-E—8-18T(7-79)) **Threaded fasteners for nuclear components.** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). Jul 1979. Contract W-7405-ENG-26. 13p. RSO.

This standard covers threaded fasteners for use in nuclear and associated applications to be manufactured from specified bolting material furnished as forgings, rod, or bar stock.

53206 (SAND—79-6001) **Insulated conductors and cables for installations NF C 32-070.** Aug 1979. Translation of pp 1-25 from Registered French Standard, NF C 32-070, May 1975. 28p. P 03/MF A01.

For many years the problem of the behavior of electrical conductors and cables in the presence of fire has often arisen in connection with the most diverse circumstances, when it becomes a matter of investigating the causes of disasters or of avoiding them, or indeed of implementing effective means of limiting their destructive effect. The numerous data gathered on these occaisons as well as the results of the many studies carried on at the same time for the purpose of improving the behavior of conductors and cables toward fire have yielded a relatively exaact picture of the material requirements and have permitted specifying tests by which conductors and cables can be judged from this point of view. The purpose of the present standard is to list the test methods recognized in the field and to define them so as to arrive at a reliable classification of conductors and cables and permit a choice as a function of the requirements of fire safety and the conditions of installation.

53207 **Mechanical engineering energetic.** Belgrade, Yugoslavia; Masinski Fakultet Univerziteta u Belgrade (1977). vp. (CONF-771277—).

From Symposium of mechanical engineering energetic; Beograd, Yugoslavia (1 Dec 1977).

Separate abstracts are prepared for the papers presented at the conference.

FUEL ELEMENTS

53208 **Clusius—Dickel effect in a nuclear fuel rod.** Loyalka, S.K.; Chandola, V.K.; Thomas, L.B. (Univ. of Missouri, Columbia). *Nucl. Sci. Eng.*; **71**: No. 1, 55-57(Jul 1979).

It is shown that in an idealized nuclear fuel rod, the Clusius—Dickel effect can lead to considerable gaseous separation and hence a higher gap conductance at the top and lower gap conductance at the bottom of the fuel rod.

53209 (LA-tr—79-29) **Possibility of using dielectric (solid-state track) detectors to measure depletion of fuel elements.** Varnad, M.; Raich, R. (Kossuth Lajos Tudomanyegyetem, Debrecen (Hungary). Kiserleti Fizikai Intezet). 1979. Translation of Paper presented at the IV. symposium on Investigations in the Field of Reprocessing of Irradiated Fuel, March 28—April 1, 1977, Carlsbad, Czechoslovakia. (CONF-7703126—1(Trans)). 14p. P 02/MF A01.

From Symposium on investigations in the field of reprocessing of irradiated fuel; Carlsbad, Czechoslovakia (28 Mar 1977).

The basis for this method is the fact that depletion can be measured by the amount of some transuranium isotopes. But the number of these isotopes can be measured, in principle, by prompt spontaneous fission neutron flux. Dielectric detectors with a converter of fissionable materials can work -- as our instruments show -- even with a very large gamma radiation background.

CONTROL SYSTEMS

53210 (ORNL/TM—2893(Vol.3)) **Tower Shielding Reactor II design and operation report. Vol. 3. Assembling and testing of the control mechanism assembly.** Ward, D.R.; Holland, L.B. (Oak Ridge National Lab., TN (USA)). Sep 1979. Contract W-7405-ENG-26. 66p. P 04/MF A01.

The mechanisms that are operated to control the reactivity of the Tower Shielding Reactor II(TSR-II) are mounted on a Control Mechanism Housing (CMH) that is centered inside the reactor core. The information required to procure, fabricate, inspect, and assemble a CMH is contained in the ORNL engineering drawings listed in the appropriate sections. The components are fabricated and inspected from these drawings in accordance with a Quality Assurance Plan and a Manufacturing Plan. The material in this report describes the acceptance and performance tests of CMH subassemblies used ty the Tower Shielding Facility (TSF) staff but it can also be used by personnel fabricating the components. This information which was developed and used before the advent of the formalized QA Program and Manufacturing Plans evolved during the fabrication and testing of the first five CMHs.

53211 **Core control optimization for scheduled load changes in large pressurized water reactors.** Karppinen, J.; Versluis, R.M.; Blomsnes, B. (OECD Halden Reactor Project, Norway). *Nucl. Sci. Eng.*; **71**: No. 1, 1-17(Jul 1979).

The problem of controlling the total power and power distribution in a large pressurized water reactor (PWR) core to follow a known time-varying load schedule has been formulated as a multistage optimization problem. The control problem is solved subject to hard constraints, which can be applied on total power, control variables and their rate of change, local power densities and their rate of change, and on more global power distribution measures such as axial and quadrant offsets. Based on a three-dimensional linearized nodal core model with some slightly nonlinear features, the optimal control problem is solved by quadratic programming. The method, called multistage mathematical programming, has been studied in simulations. A large PWR core, which was unstable with respect to both axial and azimuthal xenon oscillations, was represented by a simplified three-dimensional nonlinear nodal core simulator model. The three-dimensional oscillations were successfully damped at constant load, and an efficient anticipatory control was obtained for load cycling operation.

ENVIRONMENTAL ASPECTS

53212 (PB—290858) **Assessing the impact of nuclear-power plants on the environment. Annual progress report No. 2.** Chapman, D.G.; Lettenmaier, D.P.; Seymour, A.H.; Swartzman, G.L.; Lawson, H.E. (Washington Univ., Seattle (USA). Center for Quantitative Science in Forestry, Fisheries, and Wildlife). Feb 1979. Contract NRC-04-75-222. 184p. Y A09/MF A01.

The report assesses the wide-ranging effects that nuclear-power plants can have on the environment, which include (1) mortality to fish and other organisms resulting from impingement and entrainment in the cooling system, (2) changes in behavioral and physiological characteristics of aquatic animals by higher temperatures present in the discharge plume and (3) toxic effects of biocides,

heavy metals and radionuclides released in the aquatic or atmospheric environment.

SITING

53213 Conceptual design and estimated cost of nuclear power plants in mined caverns. Executive summary. New York, NY; Underground Design Consultants (1978). 9p. (NP—23808). California Energy Resources Conservation and Development Commission, 1111 Howe Ave., Sacramento, CA.

In 1976, the State of California enacted legislation (Section 25524.3 of the Public Resources Code) which required a study of the potential effectiveness and economic feasibility of, and the necessity for, underground siting of nuclear power reactors. The law instructed the California Energy Resources Conservation and Development Commission (CERCDC) to examine two general siting concepts: berm containment (wherein the reactor and principal radioactivity-containing structures are covered with soil); and mined caverns (wherein the reactor and principal systems are located in large caverns excavated in competent rock). This report presents design concepts and cost estimates for a nuclear power plant configured in mined caverns, a so-called rock-sited facility. Other contractors in the overall CERCDC study have considered berm-contained siting concepts and the effectiveness of subsurface siting for mitigating the consequences of severe hypothetical reactor accidents.

RADIOACTIVE EFFLUENTS

53214 (PB—291244) **Assessment of carbon-14 control technology and costs for the LWR fuel cycle. Final report.** Bray, G.R.; Miller, C.L.; Nguyen, T.D.; Rieke, J.W. (Environmental Protection Agency, Washington, DC (USA). Office of Radiation Programs). 7 Sep 1977. 170p. Y A08/MF A01.

The report is an effort to incorporate present knowledge of carbon-14 behavior in Light Water Reactors and Fuel Reprocessing Plants into Designs compatible with present technology. The impact of radioactive effluents are considered according to the traditional measure of maximum radiation dose to individuals, summation of individual annual doses to obtain a total population dose, and the environmental dose commitment. The sources of carbon-14 in LWR's and fuel reprocessing facilities are identified. Systems for the removal of carbon-14 in existing and future plants are addressed from both a technological and economic standpoint. Existing technology indicates that caustic scrubbing is the most cost-effective alternative for concurrently removing C-14 from waste-gas streams and leaving it in a form compatible with permanent disposal conditions.

RESEARCH, TEST, AND EXPERIMENTAL REACTORS

REFER ALSO TO CITATION(S) 53210, 53231, 53235, 53243, 53865

53215 (CONF-790423—15) **Performance evaluation of a drag-disc turbine transducer and three-beam gamma densitometer under transient two-phase flow conditions.** Nalezny, C.L.; Chen, L.L.; Solbrig, C.W. (Idaho National Engineering Lab., Idaho Falls (USA); Commonwealth Edison Co., Chicago, IL (USA)). 1979. Contract EY-76-C-07-1570. 19p. P 02/MF A01.

From 2. multiphase flow and heat transfer symposium workshop; Miami Beach, FL, USA (16 Apr 1979).

One of the primary variables measured in the Loss-of-Fluid Test (LOFT) Program is mass flow rate. LOFT uses drag-disc turbine tranducers (DTT) and a three-beam gamma densitometer to measure parameters from which mass flow may be computed. The transducer combination was performance tested under transient conditions in the blowdown loop at the LOFT Test Support Facility (LTSF). The performance tests consisted of three partial blowdowns of different durations starting from the same initial conditions. The reference mean mass flow rate was determined by measuring the amount of water required to reestablish initial conditions after each partial blowdown. The average mass flow rates computed from the output of the drag disc, turbine, and gamma densitometer were compared to the reference mean mass flow rates over three blowdown intervals. The tests indicated that the equal phase velocity mass measurement model provided excellent results through the use of the turbine and densitometer, and drag disc and densitometer when the phase velocities were nearly equal.

53216 (GEFR—00441) **Flow-induced vibration and hydraulic test of the FTR 0°-0°-0°/wireless advanced wire-wrap fuel bundle assembly.** Lee, K.L. (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.). Mar 1979. Contract EY-76-C-03-0893-031. 133p. AT.

A series of vibration and hydraulic tests were performed on a mock-up Fast Test Reactor (FTR) fuel assembly for the Fast Flux Test Facility (FFTF) to assess the vibrational and hydraulic characteristics under simulated flow conditions. The 217-pin advance wire wrap (0°-0°-0°Wireless) fuel assembly was tested under simulated reactor flow conditions using demineralized water to simulate the primary sodium coolant. An adjustable (across-flats) duct was used to vary the bundle-duct assembly clearance (porosity). The tests were required because of the difficulty in performing accurate analytical predictions of the fuel assembly performance due to the turbulent flow conditions and highly complex structural boundary conditions. The test results confirmed that the fuel pins met the FTR design criteria for vibrations. The fuel pins displacements were less than 2 mils (rms). The vibration behavior was similar to wire wrapped assemblies. The fuel pin response spectra were characterized by distinct, highly damped resonances at low flow rates. As the flow rate increased, the fluid-forced response dominated unitl at high flow rates the resonant response was almost completely masked by broad band fluid forces. Vibrations were relatively independent on bundle porosity but flow friction losses were definitely dependent on bundle porosity.

53217 (HEDL—6617) **Computerized Interference Elimination report: FFTF cells 489, 422E, 529A, and 529B.** (Hanford Engineering Development Lab., Richland, WA (USA)). 1979. Contract EY-76-C-14-2170. 258p. P 12/MF A01.

Design information is presented concerning the possible piping interferences in FFTF cells 489, 422E, 529A, and 529B.

53218 (HEDL-SA—1641) **Inelastic analysis of two pipelines in the Fast Flux Test Facility.** Huang, S.N. (Hanford Engineering Development Lab., Richland, WA (USA)). Jan 1979. Contract EY-76-C-14-2170. 18p. (CONF-790615—24). P 02/MF A01.

From 3. US national congress on pressure vessels and piping; San Francisco, CA, USA (25 Jun 1979).

Several complex pipelines of the Fast Flux Test Facility (FFTF) were evaluated using detailed inelastic analysis because they did not satisfactorily comply with the ASME elastic analysis rules. The purpose of the inelastic analysis is to demonstrate that the piping systems, which operate at elevated temperatures, comly with ASME Code requirements under the loading conditions specified in the Design Specification of each pipeline, using inelastic analysis rules. Two pipelines are discussed, the 8-inch Secondary Hot Leg in the Heat Transport System and the 3-inch/4-inch Primary Hot Leg (Ex-module) in the Closed Loop System. The former is made from type 304SS, operating at 965°F (518.3°C) and designed for a 20 year life; the latter is made from type 316SS, operating at 1200°F (648.9°C) and designed for a 10 year life. The MARC general finite element computer program was utilized in the analyses. The pipelines were idealized using the combinations of thin-walled circular closed section beam elements and constant bending 3-node elbow elements. Discussions on the load histograms used, the inelastic strain accumulated, and the effects of creep and fatigue on the lines are given.

53219 (HEDL-SA—1754-FP) **Observations of in-reactor strain for fueled and unfueled FTR cladding.** Gilbert, E.R.; Makenas, B.J.; Wilson, D.R. (Hanford Engineering Development Lab., Richland, WA (USA)). Jan 1979. Contract EY-76-C-14-2170. 15p. (CONF-790602—83). P 02/MF A01.

From ANS annual meeting; Atlanta, GA, USA (3 Jun 1979).

It has been demonstrated that equations derived from in-reactor creep and swelling in unfueled pressurized tubes of 20% CW AISI 316 stainless steel can be used to predict strains in prototypic FTR mixed-oxide (UO_2—PuO_2) fuel pins. For fast neutron fluences below $6 \times 10^{22} n/cm^2$ the strains were small (less than one percent) and good agreement was found (within 0.1 percent diametral strain) between the equations and the fuel pin strains. This paper describes an extension of the earlier study to fast neutron fluences up to $11 \times 10^{22} n/cm^2$.

53220 (HEDL-SA—1773) **Experience with simplified inelastic analysis of FFTF test assemblies.** Winkel, B.V. (Hanford Engineering Development Lab., Richland, WA (USA)). Feb 1979. Contract EY-76-C-14-2170. 18p. (CONF-790615—22). P 02/MF A01.

From 3. US national congress on pressure vessels and piping; San Francisco, CA, USA (25 Jun 1979).

Included in the more recent design activities for the Fast Flux Test Facility (FFTF) are a series of test assemblies which will contain experiments in the FFTF reactor. Due to high operating temperatures and severe thermal transients, inelastic analysis is generally required to demonstrate structural adequacy. Based upon previous FFTF experience, a number of simplifications have been made to reduce the inelastic analysis effort. Significant time and cost savings have resulted.

53221 (HEDL-SA—1794) **Experience in the use of FBR core component structural design criteria as applied to FFTF.** Hecht, S.L. (Hanford Engineering Development Lab., Richland, WA (USA)). 1979. Contract EY-76-C-14-2170. 10p. (CONF-790615—23). P 02/MF A01.

From 3. US national congress on pressure vessels and piping; San Francisco, CA, USA (25 Jun 1979).

User gained experience resulting from trial applications of proposed structural design guidelines for Fast Breeder Reactor (FBR) core components is presented. This work was done supporting the design analyses process for consumable core components for the Fast Test Reactor (FTR) of the Fast Flux Test Facility (FFTF). The proposed guidelines were found to be more comprehensive and generally easier to apply than those methods previously used. Component evaluation required a minimum amount of detailed inelastic analysis, primarily through the use of simplified inelastic analysis methods, as given in the guidelines. A major shortcoming of this draft criteria/guidelines is a lack of supporting irradiated material properties. Some areas of guidance given seems ambiguous and may be non-conservative, particularly those related to stress classification unique to FBR environments. Further verification of these areas appears to be in order.

53222 Power distribution and control element reactivity changes in advanced test reactor due to beryllium reflector redesign. Gregory, W.D.; Zimmermann, W.L. (EG & G Idaho, Inc., Idaho Falls). *Trans. Am. Nucl. Soc., Suppl.;* **32**: No. 1, 10-11(1979).

53223 RERTR program generic studies. Matos, J.E. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc., Suppl.;* **32**: No. 1, 29-30(1979).

53224 RERTR program fuel demonstrations. A status report. Snelgrove, J.L. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc., Suppl.;* **32**: No. 1, 30(1979).

53225 Status of the national program on the development of high-uranium-density, reduced-enrichment plate-type fuels. Stahl, D. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc., Suppl.;* **32**: No. 1, 30-31(1979).

53226 Reduced-enrichment fuel element loading calculations for the Ford Nuclear Reactor. Komoriya, H. (Argonne National Lab., IL); Lee, J.C.; Martin, W.R. *Trans. Am. Nucl. Soc., Suppl.;* **32**: No. 1, 31(1979).

53227 Utilization of lower uranium enrichment in aluminum plate- type research reactors: some design variations. Lanning, D.D. (Massachusetts Inst. of Tech., Cambridge); Bretscher, M.M. *Trans. Am. Nucl. Soc., Suppl.;* **32**: No. 1, 32(1979).

53228 Health Physics Research Reactor operating history and recent improvements. Sims, C.S. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc., Suppl.;* **32**: No. 1, 53-54(1979).

53229 Examination of a failed FLIP-TRIGA element. Richards, W. (Argonne National Lab., Idaho Falls, ID); Randall, J.D. *Trans. Am. Nucl. Soc., Suppl.;* **32**: No. 1, 54-56(1979).

REACTOR SAFETY

53230 (CONF-790802—45) **USA NRC/RSR Data Bank System and Reactor Safety Research Data Repository (RSRDR).** Maskewitz, B.F.; Bankert, S.F. (Oak Ridge National Lab., TN (USA); Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract W-7405-ENG-26. 6p. P 02/MF A01.

From International conference on structural mechanics in reactor technology; Berlin, F.R. Germany (13 Aug 1979).

The United States Nuclear Regulatory Commission (NRC), through its Division of Reactor Safety Research (RSR) of the Office of Nuclear Regulatory Research, has established the NRC/RSR Data Bank Program to collect, process, and make available data from the many domestic and foreign water reactor safety research programs. An increasing number of requests for data and/or calculations generated by NRC Contractors led to the initiation of the program which allows timely and direct access to water reactor safety data in a manner most useful to the user. The program consists of three main elements: data sources, service organizations, and a data repository.

53231 (CONF-790816—17) **Gas reactor in-pile safety test project (GRIST-2).** Kelley, A.P. Jr.; Arbtin, E.; St. Pierre, R. (Helium Breeder Associates, San Diego, CA (USA); Idaho National Engineering Lab., Idaho Falls (USA); Argonne National Lab., IL (USA)). 1979. Contract EY-76-C-07-1570. 6p. P 02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

Although out-of-pile tests may be expected to confirm individual phenomena models in core disruptive accident analysis codes, only in-pile tests are capable of verifying the extremely complex integrated model effects within the appropriate time phase for these accidents. For this reason, the GRIST-2 project, the purpose of which is to design and construct an in-pile helium loop capable of transient safety testing in the TREAT facility in Idaho, forms a cornerstone of the US GCFR safety program. The project organization, experiment program, facility, helium system design, and schedule which have been selected to meet the objectives are described.

53232 (CONF-790816—18) **Behavior of sodium—oxide and uranium—oxide aerosols in a large vessel.** Adams, R.E.; Kress, T.S.; Han, J.T.; Parsly, L.F. Jr. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 6p. P 02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

Results are reported for experiments on the behavior of sodium—oxide aerosols, uranium—oxide aerosols, and various mixtures of these in the Nuclear Safety Pilot Plant (NSPP) vessel at Oak Ridge. The NSPP Program, sponsored by the Nuclear Regulatory Commission, is to provide experimental qualification of the HAARM-3 aerosol behavioral code being independently developed at Battelle-Columbus Laboratories. The results from ten single-component and two mixed component aerosol experiments are presented along with selected comparisons with the code predictions.

53233 (CONF-790816—20) **Natural convection boiling of sodium in a simulated FBR fuel assembly subchannel.** Garrison, P.W.; Morris, R.H.; Montgomery, B.H. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 12p. P 02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

A series of single channel sodium boiling experiments were conducted in the Sodium Boiling Test (SBT) Facility at the Oak Ridge National Laboratory. The objective of these tests was to determine the maximum power that can be transferred to the coolant in a fuel assembly subchannel when the flow is driven by natural convection. Stable boiling was achieved for test times approaching one hour in duration for powers below the critical level. The power corresponding to dryout in these tests compares well with predictions from an earlier water simulation of fuel assembly voiding behavior.

53234 (CONF-790816—21) **Effects of scattering on radiative cooling of a large HCDA-produced vapor bubble.** Oezisik, M.N.; White, J.S.; Kress, T.S. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 9p. P 02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

Previous investigations have shown that radiation is potentially a significant mode of energy transfer for the cooling of a large HCDA-produced vapor bubble. The radiative cooling capability could be significantly reduced by the presence of small particles or droplets due to local condensation or fog formation. The purpose of this work is to demonstrate the separate effect of scattering on the radiative heat flux in order to determine the relative importance to conductive and convective heat transfer.

53235 (CONF-790816—29) **Application of generalized perturbation theory to fast reactor safety sensitivity studies.** Parks, C.V.; Tomlinson, E.T.; Oblow, E.M. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 11p. P 02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

A new sensitivity analysis method based on generalized perturbation theory is applied to a typical fast reactor safety code. The adjoint equations are provided for the coupled, nonlinear, conduction—convection equations as they are implemented in MELT-IIIA. An expression for the sensitivity of any temperature to problem input data is presented. In this initial application of the new methodology, two simple transient problems for the Fast Flux Test Facility are considered. Sensitivity results for various temperature responses to all thermal input data are presented. Conclusions are drawn about the practicality and advantages of developing this new sensitivity methodology. Comparisons of perturbation theory with response surface methodologies are also made throughout the paper.

53236 (CONF-790816—30) **Analysis of the heat and mass transfer processes of UO_2 bubble in sodium.** Tobias, M.L. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 6p. P 02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

The anticipated behavior of uranium oxide vapor bubbles produced by the capacitor discharge vaporization (CDV) method in the Fuel Aerosol Simulant Test (FAST) Facility is discussed on the basis of relatively simple physical models. Results of calculations for the rate of bubble rise and for heat and mass transfer rates are presented. Parametric studies indicate that future analysis efforts should emphasize the diffusion condensation process and the loss of heat from the bubble by radiation. Transfer of heat in the surrounding sodium is rapid enough that simplified models should be adequate. No important effects were noted in connection with bubble depth, initial quantity of UO_2, or initial superheat.

53237 (CONF-790816—31) **SAS3A analysis of natural convection boiling behavior in the Sodium Boiling Test Facility.** Klein, G.A. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 8p. P 02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

An analysis of natural convection boiling behavior in the Sodium Boiling Test (SBT) Facility has been performed using the SAS3A computer code. The predictions from this analysis indicate that stable boiling can be achieved for extensive periods of time for channel powers less than 1.4 kW and indicate intermittent dryout at higher powers up to at least 1.7 kW. The results of this anaysis are in reasonable agreement with the SBT Facility test results.

53238 (CONF-790816—32) **Sodium boiling incoherence in a 19-pin wire-wrapped bundle.** Wantland, J.L.; Garrison, P.W.; Nelson, W.R.; Dearing, J.F.; Gnadt, P.A.; Ribando, R.J.; Fontana, M.H. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 9p. P 02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

During various flow transients in a sodium-cooled reactor, localized boiling can occur. If this boiling does not result in dryout, significant reactor core damage is not likely. A full-length electrically heated 19-pin bundle was used to determine the extent to which dynamic boiling can be sustained before dryout occurs. Over 30 boiling runs were made with runs at three flow-power conditions culminating in dryout. Continuous boiling for time periods exceeding 20 sec was observed. Preliminary data analysis suggested that thermal inertia of the duct walls, which were backed with thermal insulation, was higher than designed and was contributing to boiling incoherence. Posttest examination confirmed that the insulation annulus had become permeated with sodium, resulting in a significantly increased thermal inertia. Detailed comparisons of experimental results with the results of several different analytical techniques indicate that incoherent boiling caused by bundle thermal inertia was responsible for the long time periods between boiling inception and dryout. This suggests that thermal inertia designed into the reactor core could prevent or delay core damage during various flow-power mismatch transients.

53239 (EGG/SEMI-TR—005) **Analysis of scaling the Semiscale Mod-3 system to a pressurized water reactor.** Rogers, G.M. (Idaho National Engineering Lab., Idaho Falls (USA)). Apr 1979. Contract EY-76-C-07-1570. 184p. P 09/MF A01.

Scaling concepts and approaches used in designing the Semiscale MOD-3 system to provide scaled simulation of the thermal and hydraulic performance of a pressurized water reactor (PWR) equipped with upper head injection (UHI) are discussed. Calculations and experimental data were used to identify the potential influence of scaling compromises on Semiscale MOD-3 system behavior for each system component. The overall capability of the Semiscale MOD-3 system for use in assessing the UHI process is not expected to be altered by these compromises; thus providing a data base for the development of codes that can be used to calculate UHI behavior. The results obtained indicate that, while Semiscale MOD-3 will not entirely duplicate the thermal hydraulic behavior of a PWR with UHI, the results should be sufficiently representative to provide information on important phenomena expected to occur in a PWR.

53240 (EGG/SEMI-TR—010) **Simulation of the Three Mile Island transient in Semiscale.** Larson, T.K.; Loomis, G.G.; Shumway, R.W. (Idaho National Engineering Lab., Idaho Falls (USA)). Jul 1979. Contract EY-76-C-07-1570. 94p. P 05/MF A01.

This report presents the results of a preliminary review and analysis of the data obtained from eight simulations of the Three Mile Island Unit 2 Nuclear Power Generating Station transient (March 28, 1979) that have been conducted in the Semiscale Mod-3 System. The Semiscale simulations of the Three Mile Island (TMI) transient were basically conducted from the same sequence of events as those recorded in the plant. System initial conditions representative of those in the TMI system were established and the transient was initiated by terminating steam generator feedwater and steam valve flow. The steam generator secondaries were drained to control primary to secondary heat transfer. The pressurizer power operated relief valve, pressurizer code safety valve, and core power trip were operated on system pressure. High pressure safety injection was activated for about one minute during the Semiscale simulations. In addition, both primary loop coolant pumps were shut off in the Semiscale simulation at the same time that the Three Mile Island loop 2A pump was shut off.

53241 (GEFR-SP—133) **Criteria for TOP or LOPI termination in a LMFBR.** Cantrell, R.T.; Peck, C.B. (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.). 12 Jan 1979. Contract EY-76-C-03-0893-032. 11p. (CONF-790816—25). P 02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

Conservative criteria are presented which relate safety test data to successful termination of Transient Overpower (TOP) and Loss of Piping Integrity (LOPI) accidents in a LMFBR. Simulated sets of test data were generated and applied to these criteria in order to predict whether real tests will establish LOA-2 success for these events.

53242 (GEFR-SP—135) **Event tree analysis of core disruptive accident consequences safety R and D planning.** Peck, C.B.; Feller, K.G. (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.). 12 Jan 1979. Contract EY-76-C-03-0893-032. 11p. (CONF-790816—23). P 02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

These results provide a basis for planning research and development to support breeder reactor safety Line-of-Assurance 3. Consequences were calculated for different combinations of reactor containment design features and accident events assumed to occur with a 2500 MW(t) liquid metal fast breeder reactor hypothetical core meltdown. The consequences provide a figure of merit for evaluating both containment system concepts, and research which demonstrates favorable natural processes, and limits on unfavorable processes in the release of radionuclides in the environment.

53243 (IDO—1570-T18) **Supplement to quick look report (QLR) L2-3, Kau-162-79.** Kaufman, N.C. (Idaho National Engineering Lab., Idaho Falls (USA)). 19 Aug 1979. Contract EY-76-C-07-1570. 37p. P 03/MF A01.

The pretest calculations of LOFT nuclear Loss-of-Coolant Experiment (LOCE) L2-3 are summarized. LOCE L2-3 was designated United States Standard Problem 10 by the Nuclear Regulatory Commission (NRC) and pretest calculations were performed by several official participants and other groups. The organizations making calculations, the computer codes used, and a brief summary of results are included.

53244 (IDO—1570-T20) **WRRD monthly report for July 1979.** (Idaho National Engineering Lab., Idaho Falls (USA)). Aug 1979. Contract EY-76-C-07-1570. 156p. P 08/MF A01.

Cost summaries are provided for the following: semiscale experiments, thermal fuels behavior program, 3-0 program, code development and analysis program, code assessment and applications program, and construction.

53245 (NUREG/CR—0765) **Experiment data report for Test RIA 1-2 (Reactivity Initiated Accident Test Series).** Zimmermann, C.L.; White, C.E.; Evans, R.P. (Idaho National Engineering Lab., Idaho Falls (USA)). Jun 1979. Contract EY-76-C-07-1570. 94p. (TREE—1271). P 05/MF A01.

Recorded test data are presented for the second of six planned tests in the Reactivity Initiated Accident (RIA) Test Series I, Test RIA 1-2. This test, conducted at the Power Burst Facility, had the following objectives: (1) characterize the response of preirradiated fuel rods during an RIA event conducted at boiling water reactor hot-startup conditions; and (2) evaluate the effect of rod internal pressure on preirradiated fuel rod response during an RIA event. The data from Test RIA 1-2 are graphed in engineering units and have been appraised for quality and validity. These uninterpreted data are presented for use in the nuclear fuel behavior research field before detailed analysis and interpretation have been completed.

53246 (NUREG/CR—0782) **Numerical procedure for calculating steady/unsteady, single-phase/two-phase three-dimensional fluid flow with heat transfer.** Shah, V.L.; Sha, W.T.; Domanus, H.M.; Krazinski, J.L.; Miao, C.C.; Schmitt, R.C.; Vanka, S.P.; Patankar, S.V. (Argonne National Lab., IL (USA)). Jun 1979. Contract W-31-109-ENG-38. 89p. (ANL-CT—79-31). P 05/MF A01.

This report describes a general numerical procedure for the calculation of steady/unsteady, single-phase/two-phase, three-dimensional fluid flow. The procedure is based on the control-volume approach, which enables the derivation of physically meaningful finite-difference equations. The conservation equations employed are based on a two-fluid model. This permits the analyses of nonhomogeneous and nonequilibrium flow conditions. In addition, surface permeabilities and volume porosities are included in the finite-difference formulations to account for dispersed solid objects in a flow domain. The derivation of the equations and the required iteration scheme are presented, and flow charts are provided for the planning and design of a computer program.

53247 (NUREG/CR—0915) **Bibliography of microfiched foreign reports distributed under the NRC reactor safety research foreign technical exchange program, 1978.** Queener, D.S. (Oak Ridge National Lab., TN (USA)). Aug 1979. Contract W-7405-ENG-26. 144p. (ORNL/NUREG/NSIC—163). P 07/MF A01.

A bibliography and indexes are presented for documents which were obtained in 1978 from France, the Federal Republic of Germany, Japan, and the United Kingdom under the NRC Reactor Safety Research Exchange Agreements and subsequently micro-

fiched and distributed. The three indexes included in this report are keywork, author, and permuted-title indexes. Microfiche copies of 305 reports are involved, including 63 French, 145 German, 57 Japanese, and 40 United Kingdom reports.

53248 (SAND—78-1106) **Evaluation of the Racon 12000-03 and 12000-04 microwave motion detection systems.** (Sandia Labs., Albuquerque, NM (USA)). Jul 1979. Contract EY-76-C-04-0789. 44p. P 03/MF A01.

A series of tests were performed on the Racon 12000-03 and Racon 12000-04 motion detection systems. The primary objectives of these tests were to determine sensor detection patterns and to quantitate the effects of intruder velocity. System susceptibility to fluorescent lights, oscillatory motion, and environmental factors was also examined.

53249 (UCID—18120) **Statistical evaluation of the performance of the time-domain PARET algorithm.** Lager, D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Jun 1979. Contract W-7405-ENG-48. 33p. P 03/MF A01.

A methodology was developed for evaluating the performance of the time-domain PARET (TDP) algorithm when processing waveforms contaminated with additive noise. The methodology is general; it may be applied to evaluating the performance of other algorithms and provides a good basis for comparison. The performance is evaluated by computing the bias, variability, and root mean square error in the parameters estimated by the algorithm when processing ensembles of waveforms. The waveforms used in this study were the displacements as a function of time from a computer simulation (by the SAP IV Program) of an eight-floor structure.

53250 (UCRL—15063) **Methods and benefits of experimental seismic evaluation of nuclear power plants. Final report.** (Anco Engineers, Inc., Santa Monica, CA (USA)). Jul 1979. Contract W-7405-ENG-48. 139p. P 07/MF A01.

This study reviews experimental techniques, instrumentation requirements, safety considerations, and benefits of performing vibration tests on nuclear power plant containments and internal components. The emphasis is on testing to improve seismic structural models. Techniques for identification of resonant frequencies, damping, and mode shapes, are discussed. The benefits of testing with regard to increased damping and more accurate computer models are oulined. A test plan, schedule and budget are presented for a typical PWR nuclear power plant.

53251 **Computer models for subassembly simulation.** Belytschko, T.B. (Northwestern Univ., Evanston, Ill. (USA). Dept. of Civil Engineering); Kennedy, J.M. (Argonne National Lab., Ill. (USA)). *Nucl. Eng. Des.;* **49**: No. 1, 17-38(Jul 1978).

Two-dimensional finite element models for the treatment of the nonlinear, transient response of fluids and structures are described. The fluid description is quasi-Eulerian, so that the mesh can move independently of the material and it includes a new finite element upwinding scheme. The structural description is based on a corotational formulation in which the coordinate system is embedded in the elements, and which is applicable to arbitrarily large rotations. The interface between the fluid and structure permits relative sliding, but because of the quasi-Eulerian fluid description the nodes of the fluid and structure can be allowed to remain contiguous. Modelling procedures for treating the various aspects of subassemblies, such as the narrow fluid channels, the fuel bundles which are immersed in the coolant, and the axial flow, are developed. Calculations are made for a symmetric seven-subassembly cluster and compared to experimental results. In addition, the application to a 19-subassembly cluster is described.

53252 **Series of bursting experiments on medium size pressure vessels in the context of the American HSST Programme.** Canonico, D.A. (Oak Ridge National Lab., Tenn. (USA)); Engel, J.; Kautz, H.R. (Babcock - Brown Boveri Reaktor G.m.b.H., Mannheim (Germany, F.R.)). *VGB Kraftwerkstech.;* **58**: No. 6, 449-455(Jun 1978). (In German).

The experiments on medium size pressure vessels with defined concentrated faults permit comparison of the experimentally determined bursting behaviour with the results of previously determined analytical calculations. Estimates of extension at fracture based on linear elastic fracture mechanism LEBM calculations were accurate in those cases where (1) faults were arranged in areas of high transverse restraint and (2) the fracture strength valves were so low that crack instability occurred before the whole wall region started to flow. LEBM calculations of the critical load started from fracture strength data, which were determined from small samples. When the whole wall region started to flow, the actual extensions were noticeably greater than the fracture extensions calculated using the LEBM. In these cases the strength of the vessel no longer depends on the strength in the even extension condition (elastic extension), but on the ability of the damaged area to carry the load on it stably up to the plastic flow condition. The ability of the faulty vessel to carry load up to flow of the whole wall region has important qualitative effects on the safety margin of pressure vessels. The whole flow condition occurs in LWR pressure vessels at about double the design pressure. This pressure vessel load condition is generally far above the normal and fault operation and emergency conditions which are usually supported and taken into account.

53253 (COO—4261-8) **Convective heat transfer correlations for molten core debris pools growing in concrete.** Felde, D.K.; Kim, H.S.; Abdel-Khalik, S.I. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). [nd]. Contract EN-77-S-02-4261. 5p. P 02/MF A01.

The heat and mass transfer processes taking place in volumetrically-heated pools are of interest because of their relevance in post accident heat removal analyses for fast reactors. Earlier studies on volumetrically-heated pools have focused on natural convection phenomena. These, however, do not apply for molten core debris pools growing in concrete since large amounts of gas will be released by the concrete. These gases will vigorously mix the pool. Knowledge of the heat transfer rates at the pool boundaries is necessary in order to assess the passive core retention capability of the concrete support structure below the reactor vessel. Hence, the main objectives of this investigation have been to experimentally simulate the gas evolution process at the pool boundaries and determine the effect of gas release on the heat transfer rates along the boundaries. Nusselt-type correlations have been obtained for the downward, sideward, and upward heat transfer rates.

ENERGY STORAGE

FLYWHEELS

REFER ALSO TO CITATION(S) 53062

53254 (COO—4094-44) **Flywheel energy storage interface unit for photovoltaic applications.** Millner, A.R.; Hay, R.D. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 1979. Contract EY-76-C-02-4094. 5p. (CONF-790803—42). P 02/MF A01.

From 14. intersociety energy conversion conference; Boston, MA, USA (5 Aug 1979).

A flywheel energy storage and conversion system has been designed and a prototype is now being built at Massachusetts Institute of Technology/Lincoln Laboratory for the US Department of Energy. It is intended to serve as an interface between a solar photovoltaic array and an ac load, providing output waveform regulation as well as energy storage. Important features include magnetic bearings, an ironless armature motor generator and a low-cost flywheel rotor. The system design and prototype characteristics are described, a preliminary economic analysis is given.

THERMAL

REFER ALSO TO CITATION(S) 52895, 52896, 52897, 52898, 52909, 53039, 53040, 53041, 53042, 53043, 53044, 53046, 53047, 53048, 53109

53255 (LBL—8883, pp 108-111) **Depth constraints on thermal storage wells.** Morrell, G.O.; Collins, R.E. (Univ. of Houston, TX). 1978.

From 2. international well-testing symposium; Berkeley, CA, USA (25 Oct 1978).

Downhole pumps have been suggested as providing satisfactory production capacity for aquifer thermal storage wells. This problem of assuring adequate production capacity for aquifer thermal storage wells is intimately related to the problem of water flashing to steam and associated scale formation within the well production tubing and in the aquifer. These related problems are addressed and depth constraints on aquifer storage wells defined to assure successful pumping operations.

53256 (ORNL/Sub—7299/1) **Use of solid-state phase transitions for thermal energy storage. Final report, June 1, 1977—August 31, 1978.** Leffler, A.J.; Myers, J.; Weinstein, D. (Villanova Univ., PA (USA). Dept. of Chemistry). 1978. Contract W-7405-ENG-26. 42p. P 03/MF A01.

A study has been carried out on the feasibility of using solid-state phase transitions for thermal energy storage. As part of this study a literature search was made to identify the most promising types of compounds and a synthesis program was carried out to prepare certain of these substances. In addition a large number of compounds for testing were obtained from commercial sources. All of the compounds were screened for transitions using a Perkin Elmer DSC-1B differential scanning calorimeter. From this program seven

compounds were found that have transition energies from 20-30 cal/g in the temperatre range of 335-405 K. The most promising compound found is 5-norbornene-2,3-dicarboxylic acid anhydride having a transition of 22.6 cal/g at 366 K and an estimated cost of peparation of $0.40/lb..

CHEMICAL

REFER ALSO TO CITATION(S) 52895, 52896, 52897, 52898, 52909

BATTERIES

DESIGN AND DEVELOPMENT

REFER ALSO TO CITATION(S) 53259

53257 (ANL—79-39) **High-performance batteries for electric-vehicle propulsion and stationary energy storage. Progress report, October 1978-March 1979.** (Argonne National Lab., IL (USA)). May 1979. Contract W-31-109-ENG-38. 151p. P 08/MF A01.

This report covers the research, development, and management activities of the programs at Argonne National Laboratory (ANL) and at subcontractors' laboratories on high-temperature batteries during the period October 1978 to March 1979. These batteries are being developed for electric-vehicle propulsion and for stationary energy-storage applications. The present cells, which operate at 400 to 500°C, are of a vertically oriented, prismatic design with one or more inner positive electrodes of FeS or FeS_2, facing electrodes of lithium-aluminum alloy, and molten LiCl-KCl electrolyte. During this six-month period, cell and battery development work continued at ANL, Eagle-Picher Industries, Inc., Gould Inc., and the Energy Systems Group of Rockwell International. Fabrication of a 40-kWh battery by Eagle-Picher for testing in an electric van is nearing completion. Cost and design studies for a Mark II electric-vehicle battery, which will have somewhat higher performance and use potentially low-cost materials and fabrication methods, were conducted by all three subcontractors, and contracts are being negotiated for development of Mark II batteries. Conceptual design studies continued at Rockwell International on a 100 MWh stationary energy-storage module. The present plan is to construct a module based on these designs for testing at the BEST (Battery Energy Storage Test) Facility. Work was also in progress at the Carborundum Co., General Motors Research Laboratories, and various other organizations on developing materials and components for cells. 38 figures, 28 tables.

PERFORMANCE AND TESTING

53258 (SAND—79-0487) **Long-term lithium battery tests.** Levy, S.C. (Sandia Labs., Albuquerque, NM (USA)). Jun 1979. Contract EY-76-C-04-0789. 18p. P 02/MF A01.

A 6-year test of ambient-temperature lithium batteries has been initiated. Lithium—sulfur dioxide cells from three manufacturers and lithium—polycarbon monofluoride cells from a fourth manufacturer are included. Capacity vs rate, storage, and simulated operation are being studied. Capacity vs rate is plotted for all four manufacturers' cells. Data taken 6 months into the test indicate that storage at room temperature or below has no effect on delivered capacity. Storage at 49°C results in a loss of approximately 5 to 6% of capacity. Continuous low-rate discharge has been shown to be the worst condition for these cells.

53259 (SAND—79-0834) **Thermal model of a thermal battery.** Bush, D.M.; Hughes, R.L. (Sandia Labs., Albuquerque, NM (USA)). Jul 1979. Contract EY-76-C-04-0789. 54p. P 04/MF A01.

Thermal batteries which operate at elevated temperatures (e.g., 500°C) are activated by a pyrotechnic heat source. The ensuing temperature profile is a function of several factors including battery configuration, phase changes, and internal heat generation. A thermal model was developed to predict the effect of design changes, such as an increase in insulation thickness, on the temperature—time profile of the battery. The model is based on a quarter section of the battery, which is divided into a 10 x 20 grid consisting of 200 nodes. A method of calculating an effective conductivity/distance term between nodes negates the need for special boundary temperature calculations at material interfaces. A separate routine is used to account for the heat of fusion released by the buffer pellets. Individual variables, as well as the eight data arrays corresponding to the node distribution, can be easily changed to reflect changes in the battery design. Actual design changes selected to check the model were internal heat generation, removal of stack end plates, new electrochemical system, increased side insulation, and internal electric heater. Results of model runs reflecting these changes are compared with temperature—time histories recorded from battery tests, and a close correlation is obtained in each case. 16 figures, 3 tables.

ENERGY MANAGEMENT AND POLICY

53260 (LBL—9391) **Appropriate Energy Technology Library bibliography.** Clark, H.R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1979. Contract W-7405-ENG-48. 87p. P 05/MF A01.

Lawrence Berkeley Laboratory discovered the need for a library of books dealing with technologies on a smaller scale than that of customary laboratory projects. These books introduce researchers to the inventive and ecology-conscious thinking (in its various social and cultural milieus) that lies behind the drive for small-scale self-reliance. The introduction explains the philosophy behind the library, the browsing system of the library, and the makeup of the bibliography. The books included may be classified as follows: workshop books, city and village technologies, transport and military; energy in general, soft and hard; nuclear and fossils, the hard stuff; electricity; relatively unfamiliar cultures, population and food problems; ecology and economics, ocean ecology; history and philosophy, ideas and predictions; conservation and recycling; catalogs; alternative energy and appropriate technology, the soft stuff; solar techniques; design; passive and alternative energy houses; heat pumps and plumbing; codes and laws; construction, tools and materials; solar greenhouses; farming and simple living; food, agriculture and small gardens; land, its use and care; forestry and wood, wood stoves; other biomass; water power, pumps and wheels; wind; geothermal; atlases and references. (RWR)

ENERGY ANALYSIS AND MODELING

REFER ALSO TO CITATION(S) 52555, 53306, 53406

53261 (BNL—26452) **Integrated methodology for assessing energy-economy interactions.** Lukachinski, J.; Groncki, P.J.; Tessmer, R.G. Jr.; Goettle, R.J. IV; Hudson, E.A. (Brookhaven National Lab., Upton, NY (USA); Jorgenson (Dale W.) Associates, Cambridge, MA (USA)). 1979. Contract EY-76-C-04-0789. 17p. (CONF-791007—2). P 02/MF A01.

From Energy systems analysis international conference; Dublin, Ireland (9 Oct 1979).

Brookhaven National Lab. (BNL) has collaborated in development of an integrated technological and econometric representation of the nation's energy and economic systems. Among the applications of this integrated methodology are the assessment of energy-economy interactions, benefit/cost analyses of alternative energy policies, and multi-objective supply and demand studies relating to energy R and D and technology change. The integrated analytical system is comprised of three component models. The economic growth model included in this framework is the Dale W. Jorgenson Associates (DJA) Long-term Interindustry Transactions Model (LITM). The LITM model provides a flexible, interindustry representation of sectoral production and final demand, and captures the combined influences of productivity, investment, and labor supply on the long-term expansion of US productive capacity. The second component of this model system is a detailed technological model of energy supply, conversion, and end-use demand. The Time-stepped Energy System Optimization Model (TESOM) developed by BNL represents the full feasible range of energy resource and technology substitutions for the US energy system. The final component of this model framework is the input-output model developed jointly by BNL and the Univ. of Illinois. This detailed input-output model of the structure of the US economy maps the outputs of the conventional energy-supply and -conversion sectors into non-substitutable energy-service demands for each interindustry sector and final demand. The BNL/DJA combined model system provides a comprehensive long-run representation of US energy consumption and energy-economy interactions.

53262 (DOE/EIA—0103/32) **READ interfaces.** Hopkins, F.E.; Parkizgari, A.; Tannen, M. (Department of Energy, Washington, DC (USA). Energy Information Administration). 6 Nov 1978. 47p. P 03/MF A01.

The energy-modeling capability of the Energy Information Administration currently suffers from an inadequate interaction between regional economic activity and regional energy demand. This weakness is primarily in the feedback from regional energy supplies, demands, and prices from the Mid-Range Energy Forecasting System to regional economic and demographic activity. The Regional Energy, Activity, and Demographic (READ) Model is being constructed to correct this problem. The structure of required interfaces between READ and other models to achieve this goal is the

topic of this paper. The READ Model will provide an analytical capability for any region that can be defined as an aggregation of counties. The READ Model will provide regional forecasts of energy using activities to drive various Structural Econometric Energy Demand (SEED) Models. A list of the READ forecasted variables that can be used in the interfaces is presented. A general overview of the current and proposed EIA Mid-Range Modeling Interface system is presented. The SEED Model interfaces are described, and the use of the READ Model to drive other impact models is discussed.

53263 (DOE/EIA—0103/33(Draft)) **READ Model validation procedures.** Disbrow, J.; Durst, M.; Hopkins, F. (Department of Energy, Washington, DC (USA). Energy Information Administration). Sep 1978. 57p. P 04/MF A01.

This paper presents a general discussion of the procedures used to validate the three areas of the Regional Energy, Activity, and Demographic model development: data and data management, software, and econometric results. Since general EIA guidelines for model validation do not currently exist, this paper may provide the basis upon which to build the guidelines. The READ model development plan, which is divided into three phases, has been designed to include an endogenous validation scheme. The first phase involves construction of a preliminary model, which while having immediate application in DOE, will also provide (1) a data base, (2) a software system, and (3) a set of well specified equations for use in the second phase of model development. The second phase of the model will build upon the results of the preliminary model. The second generation version, or full-scale READ model, will have expanded industrial, state and local government, and demographic, employment, and income sectors. The third phase of the model will consist of the addition of an environmental sector to the full READ model.

53264 (DOE/EIA—0103/34(Draft)) **Regional Energy, Activity, and Demographic (READ) Model: description and applications.** Hopkins, F.E.; Morlan, T.H. (Department of Energy, Washington, DC (USA). Energy Information Administration). Sep 1978. 51p. P 04/MF A01.

This paper describes how the READ model, being developed in the Energy Information Administration, can be utilized for policy and analysis. The model is designed to provide energy-sensitive forecasts of industrial activity, construction activity, income, employment, and population changes, and the activities of state and local governments at various levels of regional detail. It can be directly related to policy analysis in three major areas: (1) It provides inputs into the Structural Econometric Energy Demand (SEED) models, which will form the demand side of DOE's second generation Mid-Range Energy Forecasting System; (2) Since the READ model will be integrated with a general-equilibrium energy model, it can provide energy-sensitive regional-impact analysis of national energy policies on economic activity, demographic trends, and the activities of state and local governments; and (3) In addition to its use for forecasting and impact analysis, the data base and computer software that have been compiled to estimate the model can be used to analyze non-READ related policy problems. This paper is divided into two major themes. First, the structure of the model is outlined. Second, the capability of the model is analyzed by answering hypothetical policy questions that have previously been asked.

53265 (DOE/EIA—0103/35) **User's guide to the READ estimation and simulation software system.** Disbrow, J.; Durst, M.; Hopkins, F.; Morlan, T.; Rubin, L. (Department of Energy, Washington, DC (USA). Energy Information Administration). 26 Sep 1978. 25p. P 02/MF A01.

The Regional Energy, Activity and Demographic (READ) Model utilizes data for 11 years from 3,112 counties and for over 2500 variables. In January, 1977, the Federal Energy Administration did not possess an econometric software and data retrieval system for efficiently meeting the data processing requirements of the READ model. This User's Guide presents a general discussion of the estimation and simulation software that has been developed since January, 1977. This system is general enough to be of use in any pooled cross-section and time-series econometric analysis. The technical level of this manual is aimed at the nonprofessional programer with a modest background in statistics. A brief description of the READ model is presented. The direct access regression preprocessor that transforms the data for use in the estimation and simulation routines is discussed. The algorithms used in the estimation and in the simulation programs are outlined. Forecasting procedures that incorporate national control totals, procedures for the adjustment of unrealistic growth rates of forecasted variables, and the relationship of the READ forecasts to the PIES scenarios are described. Finally, the information presented in the User's Guide is summarized and planned modifications to increase both the computer and the econometric efficiency of the software system are discussed. 4 figures, 2 tables. (RWR)

53266 (EPRI-EA—1115) **Wharton Annual Energy Model: development and simulation results. Final report.** Finan, W.; Schink, G.R. (Wharton (E.F.A.), Inc., Philadelphia, PA (USA)). Jul 1979. 92p. P 05/MF A01.

This project has sponsored an extensive and detailed expansion of the energy sector of a well-known, commercially available macroeconomic model. The research was undertaken primarily in order to develop a tool for examining future energy-economy interactions. The current report reviews the development of modifications in the model and describes the specific methodologies employed. A set of energy policy simulations using the newly expanded model is also presented.

53267 (TID—29380) **Optimization of large-scale deterministic systems using descriptor variable theory and spatial dynamic programming. Topical report, March 1976-February 1978.** Larson, R.E.; Luenberger, D.G.; Stengel, D.N. (Systems Control, Inc., Palo Alto, CA (USA)). Feb 1978. Contract EX-76-C-01-2090. 57p. P 04/MF A01.

Descriptor variable theory is a new approach for analyzing systems that preserves structure and allows considerable flexibility in modeling. This report summarizes the fundamental concepts used in descriptor analysis and some results concerning the structural properties of certain classes of descriptor systems. Optimization of a wide class of linear descriptor systems for quadratic performance criteria is discussed in detail. Spatial dynamic programming is a new approach to optimization that is particularly well-suited for large-scale systems by its exploitation of spatial structure. The procedure and its implications for large-scale systems design and control are described in the report.

ECONOMICS AND SOCIOLOGY

REFER ALSO TO CITATION(S) 53261, 53277, 53279, 53297, 53702

53268 (DOE/EIA—0194/2) **Dynamic generalized equilibrium model and incorporation of materials and energy detail.** Hudson, E.A.; Jorgenson, D.W. (Data Resources, Inc., Cambridge, MA (USA)). 30 Nov 1977. Contract EM-77-I-01-8236. 77p. P 05/MF A01.

The extension of the 35 sector dynamic, generalized equilibrium model to incorporate detailed information on the use of materials and fuels in the economy is described. The system analyses economic activity on a sectoral basis, incorporating behaviorial submodels of producer and of consumer activity. Each of 26 materials and 12 fuel inputs will be identified and their impacts calculated.

53269 (DOE/ERA—6391-1) **Costs of capital and rates of return for industrial firms and Class A and B electric utility firms.** (Ernst and Ernst, Washington, DC (USA)). Jun 1979. Contract EB-78-C-01-6391. 237p. P 11/MF A01.

The intent of the Powerplant and Industrial Fuel Use Act of 1978 (FUA) is to deter industry and electric utilities from using oil or natural gas as a primary boiler fuel. This study was undertaken to assist the Economic Regulatory Administration both in developing discount rates for use in the cost test, and in developing measures of the rate of return for use in assessing the economic health of the petitioning for exemption. The findings reported in this study were developed under a series of economic assumptions that are discussed in detail in Chapter 2. The most significant are: the assumption of rational economic behavior, the efficient market assumption, and the going concern assumption. Chapter 3 presents the methods of estimation. Cost of capital and rate of return for industrial firms (Chapter 4) and utility firms (Chapter 5) are presented. In addition, 7 technical appendices are presented to provide mathematically complex derivations and to clarify concepts and procedures.

53270 (FE—6391-T1) **Costs of capital and rates of return for industrial firms and Class A and B electric utility firms.** (Ernst and Ernst, Washington, DC (USA)). Jun 1979. Contract EB-78-C-01-6391. 239p. P 11/MF A01.

The intent of the Powerplant and Industrial Fuel Use Act of 1978 (FUA) is to deter industry and electric utilities from using oil or natural gas as a primary boiler fuel. Under the FUA, industries and utilities must convert existing boiler facilities and build any new boiler facilities to burn coal or alternate fuel. This requirement may place a significant capital requirement on firms that must comply with the FUA. This study was undertaken to assit the Economic Regulatory Administration both in developing discount rates for use in the cost test, and in developing measures of the rate of return for use in assessing the economic health of firms petitioning for exemption. The cost of capital for industrial and utility firms was estimated for a sample of 54 energy-intensive industrial firms and 118 Class A and B electric utility firms. Fur purposes of this study, the cost of capital at the margin was assumed to be the weighted average cost of new financing. Weighting factors for each firm were calculated as the most recently available book value of each component of the capital structure, divided by the firm's total capitalization. A theo-

retical discussion of the firm's cost of capital and rate of return, methods of estimation, cost of capital and rate of return for industrial firms, and cost of capital and rate of return for utility firms are presented. In addition, seven technical appendices are presented to provide mathematically complex derivations and to clarify concepts and procedures.

53271 (MTR—7651) **Typical business and marketing plan for an energy-related small business.** Eldridge, F.R. (Mitre Corp., McLean, VA (USA). METREK Div.). Oct 1977. Contract EX-77-C-01-6073. 22p. P 02/MF A01.

Guidelines are provided for the preparation of a business and marketing plan that would be appropriate for individual inventors or small businesses to submit to the private sector for purposes of obtaining venture capital or other forms of support for energy-related inventions, and associated systems.

ENVIRONMENT, HEALTH, AND SAFETY

REFER ALSO TO CITATION(S) 52513, 52516, 52759, 53278, 53361, 53362, 53408, 53703

53272 (PB—291181) **A national environmental/energy workforce assessment. Post-secondary education profile: energy. Final report on phase 2.** (National Field Research Center, Inc., Iowa City, IA (USA)). Dec 1978. 342p. Y A15/MF A01.

This study is one of 16 volumes aggregating data on representative environmental education offerings in the United States at post-secondary education institutions and in the private sector of the economy. Structured around on-site interviews, the study describes the institutions' education programs--their program structure, representative course offerings, faculty structure, and program requirements. In addition, the study provides information on the employment history of graduates. Designed as Phase II of a three-phase program, the study presents the information on schools with emphasis on energy. The study is an overview. It doesn't include all environmental programs in the United States, and it makes no attempt to evaluate the program offerings.

53273 (PB—291757) **Electric power generation and transmission decisions affecting fish and wildlife resources.** (Asplundh Environmental Services, Willow Grove, PA (USA); United Engineers and Constructors, Inc., Philadelphia, PA (USA); Ichthyological Associates, Inc., Middletown, DE (USA)). Jul 1978. 117p. Y A06/MF A01.

This report discusses, in broad scope, the existing regulatory operations of Federal and state agencies and describes the operations of systems. It also defines the timing and requirements of key events within the decision making process as they affect the licensing (construction, operation permits) of electric generation facilities. Key decisions which may affect fish and wildlife resources have been identified and discussed.

53274 (UCID—18255) **Results of the 1978-79 consensus forecast experiment.** Quirk, W.J.; Knox, J.B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Aug 1979. Contract W-7405-ENG-48. 19p. P 02/MF A01.

The present oil shortage demonstrates the urgent need for better forecasts of climate variations. As a means of focusing on this problem, LLL sponsored an experiment in seasonal forecasting. The principal investigator from LLL, Joseph B. Knox, assembled these inputs and developed a consensus forecast for the upcoming winter season. Because these forecasts are still highly experimental, the material was intended only for purposes of information and evaluation. A conference was held in May 1979 to evaluate the results of the forecast and identify ways in which present seasonal climate forecasts can be made more useful to the DOE forecast users; this document summarizes those discussions. The methods used by the various participants are cited to discuss the results. The principal findings for the experiment were: (1) the forecasts had skill typical of previous forecasts, about 10% better than chance; (2) the major cause of failure in the forecasts was the development of an unanticipated blocking pattern in the North Atlantic; (3) more research has to be done to better define the impact of climate variations on energy demand; (4) better temporal resolution is needed for the monthly and seasonal forecasts; and (5) better spatial resolution for degree-day statistics and forecasts is needed by FERC to calculate effects on pipelines.

53275 **Energy analysis and the coupling of man and estuaries.** Odum, H.T. (Univ. of Florida, Gainesville); Kemp, W.; Sell, M.; Boynton, W.; Lehman, M. *Environ. Manage.;* **1**: No. 4, 297-315(1977).

New concepts and insights concerning human and natural systems in the coastal zone are emerging from recent energy analysis and synthesis studies. By using new concepts for measuring the quality of energy, one can express the work of ecosystems and human economies in equivalent terms. From energy models and new energy quality evaluations, one can learn what kinds of coastal systems maximize power, are competitive, economically vital, and likely to have a survival advantage. Energy analysis and synthesis is aided by energy circuit diagrams. Models of the coastal zone that emphasize the change in external driving functions related to world energy sources provide insights and some predictive abilities that are not found in economic studies, since money flows alone do not evaluate external driving energies. This paper suggests four procedures for coastal planning: calculation of investment ratio in units of equal quality to determine which projects are economic in a broad sense, development of energy signatures for coastal ecosystems, determination of which interface ecosystems develop the best energy flows, and development of regional models that include the main features of human and natural ecosystems.

NATURAL RESOURCES

REFER ALSO TO CITATION(S) 53283, 53308, 53351, 53358, 53359, 53701

53276 (ANL/CNSV-TM—5, pp 19-23) **Implementation steps and techniques.** Barker, J. Jun 1979.

In Proceedings: energy from urban wastes workshop, Washington, DC, September 11-12, 1978.

Five ingredients are outlined for implementing a resource recovery project: (1) availability of refuse for feedstock, (2) markets for the recovered products, (3) adequate technology at an environmentally suitable site, (4) a partner to organize the technical and business aspects, and (5) a financing package. Several risks are noted, such as unproven technologies, uncertain financing and supplies, and an unreliable market. If resource recovery is approached and structured as a manufacturing activity that can help with solid waste management, keeping the above risks in mind, it can be beneficial to everyone involved.

53277 (ANL/CNSV-TM—5, pp 25-37) **Financing solid waste/recovery systems.** Ballard, C.A. Jun 1979.

In Proceedings: energy from urban wastes workshop, Washington, DC, September 11-12, 1978.

To establish the advisability of solid waste disposal/resource recovery systems, several charts are presented as aids in outlining the various financing options available to a municipality and on which it can make a judgment before proceeding. Resource recovery is essentially a business and should not impose significant risks on the bondholders. General obligation bonds, special revenue bonds, industrial development revenue bonds, private sector financing, and combinations of these options illustrate the range of financing opportunities available as they are used by four cities.

53278 (ANL/CNSV-TM—5, pp 39-42) **Resource Conservation and Recovery Act.** Lingle, S. Jun 1979.

In Proceedings: energy from urban wastes workshop, Washington, DC, September 11-12, 1978.

The goals and operation activities of the Resource Conservation and Recovery Act are described, with emphasis given to those sections dealing explicitly with authority and guidelines: Sections 2003, 4002, 4003, 4008, 6002, and 8000. This legislation enables the Environmental Protection Agency to provide state and local governments with assistance in planning and developing projects for resource recovery. The EPA's present focus is on urban policy grants, now funded at $15 million, that are designed to help local governments finance resource recovery systems. The Act also covers research and development, demonstration, and evaluation activities.

53279 (ANL/CNSV-TM—5, pp 43-47) **Role of the Department of Commerce: resource recovery.** Herbst, R. Jun 1979.

In Proceedings: energy from urban wastes workshop, Washington, DC, September 11-12, 1978.

The role assigned to the Commerce Department in the Resource Conservation and Recovery Act of 1976 is described as it is specified in Sections 5001-5003 of Subtitle E. Largely promotional in nature, the Department's responsibility is to set specifications and standards for recovered materials, stimulate markets, promote proven technologies, and promote the exchange of technical and economic data. The Secretary is asked to locate existing markets, identify any economic and technical barriers, and encourage new uses for recovered materials. The Department's interpretation of this assignment and its present activities are summarized.

53280 (ANL/CNSV-TM—5, pp 49-55) **Department of Energy program in resource recovery.** Rines, C. Jun 1979.

In Proceedings: energy from urban wastes workshop, Washington, DC, September 11-12, 1978.

The DOE's involvement in resource recovery is aimed at conserving fossil fuels and virgin materials resources by substituting urban waste as an energy and materials source and by reducing the

amount of energy used to process wastes. DOE's effort focuses on five specific areas - three technical process options, non-technical aspects of implementation, and general program support. Research and development on technical options is concentrated on thermal, mechanical, and biochemical technologies. A status report on several technologies includes institutional as well as technical problems and suggests new areas for innovative initiatives.

53281 (ANL/CNSV-TM—5, pp 57-59) **Summary of discussions.** Jun 1979.

In Proceedings: energy from urban wastes workshop, Washington, DC, September 11-12, 1978.

A synopsis is given of comments made at two panel discussions held during the Urban Wastes workshop. The comments are grouped under three general topics: the roles of government, problems, and attitudes. Areas of conflict or disagreement are reported as they were expressed, with no effort to make an editorial resolution or to separate opinion from fact.

53282 (ORNL/TM—6912) **Desalting seawater and brackish water: cost update, 1979.** (Larson and Associates Ltd., San Diego, CA (USA)). Aug 1979. Contract W-7405-ENG-26. 53p. P 04/MF A01.

This report updates and expands on the scope of data presented in ORNL/TM-5926, published in November 1977. Since the previous report, overall plant equipment costs have increased approximately 7%/y and the costs of civil works and switchgear have increased at an annual rate of 7 to 8%. Operation and maintenance costs have increased about 7%/y. On average, the cost of desalting seawater by distillation has increased 25 to 30%. On a comparable basis, both electrodialysis and reverse osmosis costs have increased from 15 to 30% depending on plant size and feedwater compositon.

RESEARCH, DEVELOPMENT, DEMONSTRATION, AND COMMERCIALIZATION

REFER ALSO TO CITATION(S) 52767, 53350, 53396, 53986

53283 (NP—23551) **Program for Energy Research and Technologies 1977—1980. Annual report 1977 on efficient uses of energy fossil sources of primary energy new sources of energy.** (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Project Management for Energy Research (PLE)). 1978. 1033p. (In German and English). U 99/MF A01.

The main objectives within the policy of the Federal Government Program for Energy Research and Technologies 1977—1980 can be summarized as follows: guaranteeing the continuity of energy supply in the medium to long term in the Federal Republic at economically favourable costs considering the requirements necessary for the protection of the environment and population. The financial support is effected under the general headings of Development of Energy Resources, Energy Conservation and Efficient Use of Energy. An additional aspect of the support policy is the development of technologies which are of importance for other countries, specifically for the developing countries. Support of a project is effected through a research and development grant from the Federal Government and this can range from less than 50% to 100%. For this the Government receives an irrevocable, free of charge and non-exclusive right to make use of research and development results. In special cases full repayment is agreed subject to commercial success. Based on agreements signed by the Federal Minister of Research and Technology and the Federal Minister of Economic Affairs on the one hand and the Juelich Nuclear Research Establishment (KFA) on the other, the Project Management for Energy Research (PLE) in KFA Juelich is acting on behalf of these Ministries. The Project Management's activities in non-nuclear energy research in general (for the Federal Ministry of Research and Technology) and development and innovation in coal mining and preparation (for the Federal Ministry of Economic Affairs) have the following general objectives: to improve the efficiency of Government support; to ensure that projects are efficiently handled; and to reduce the workload of the Ministries. The individual projects are listed and described briefly.

NUCLEAR ENERGY

REFER ALSO TO CITATION(S) 52657, 53156, 53158, 53168, 53326, 53348

53284 (DOE/ER—0025-D) **Nuclear strategy of the Department of Energy.** (Department of Energy, Washington, DC (USA). Office of Energy Research). Apr 1979. 92p. P 05/MF A01.

An analysis of the important technical and economic parameters related to the timing and future deployment of nuclear power in the US is presented. The anaysis is used first to form the basis of a set of alternative nuclear strategies and then to assist in a critical evaluation of these strategies. The strategies involve major decisions on breeder commercialization, fuel cycle development, and strengthening the nuclear option in the US. DOE energy projections indicate that nuclear power must play a substantial role in meeting future US energy needs, even under assumptions that are otpimistic with respect to energy conservation and the increased use of coal-fired generating plants. Also, estimates indicate that nuclear power can have a substantial cost advantage in certain areas of the US. However, these estimates involve significant uncertainties, such as the relative environmental impact of the nuclear and coal cycles and the costs of meeting new environmental performance standards. There are three main elements in the fission portfolio: programs which extend the uranium resource base or which add to the efficiency of its use; breeder programs; and enabling programs.

53285 (PNL—2743) **Public policy issues in nuclear waste management.** Nealey, S.M.; Radford, L.M. (Battelle Human Affairs Research Center, Seattle, WA (USA)). Oct 1978. Contract EW-78-C-06-1076. 98p. P 05/MF A01.

This document aims to raise issues and to analyze them, not resolve them. The issues were: temporal equity, geographic and socioeconomic equity, implementation of a nuclear waste management system, and public involvement.

53286 (PNL—2808) **Radioactive wastes: public attitudes toward disposal facilities.** Lindell, M.K.; Earle, T.C.; Hebert, J.A.; Perry, R.W. (Battelle Human Affairs Research Center, Seattle, WA (USA)). Oct 1978. Contract EW-78-C-06-1076. 65p. P 04/MF A01.

Seventeen geographically widespread, established groups were selected which were expected to vary in their attitudes from strongly pronuclear to strongly antinuclear. People who tend to be politically active were chosen. The highest level of consensus was found on the need for site monitoring, site control, and information transfer in a waste repository. Overall, the results indicate that pronuclear respondents believe that the hazards of nuclear waste are similar to other industrial risks, while antinuclear respondents are less optimistic about safe storage of nuclear wastes and believe that nuclear power is different.

53287 **Radioactive waste disposal.** Deutch, J.M. (Department of Energy, Washington, DC). *Proc. Am. Power Conf.;* **40**: 68-73(1978). (CONF-780440—).

From American power conference; Chicago, IL, USA (Apr 1978).

The author believes the problem of radioactive waste management is the crucial aspect of nuclear power public acceptance. Any plans for radioactive waste management must be responsive to state governments, congressional delegations, and public interest groups. Plans should also be subjected to licensing by the Nuclear Regulatory Commission. An interagency task force formed by President Carter will commit governmental agencies to establish credible implementing programs and schedules. The anticipated product of this interagency task force will be a legislative package that will establish both the legal authority and the required budgetary authority to carry out the programs. It will also lead to Presidential policy decisions on radioactive waste management. Findings of the Department of Energy Task Force Report on radioactive waste management were discussed briefly as well as the author's direct responsibilities in waste management. The author stated that too much time was being spent fighting lost causes like the Clinch River Breeder Reactor Project. Instead of discussing and continuing to go over issues such as speculation about what the uranium resource base is in the United States and how soon, if ever, reprocessing is required, the focus should be design, construction, and licensing of once-through light water reactors.

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 53044

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 52870, 52871, 52872, 52873, 53136, 53139, 53400, 53401, 53412

53288 (ANL/CNSV-TM—12) **Analysis of costs and scarce fuel savings associated with nine Eastern and North Central center city conversions to a district energy system.** Davis, A.A.; Santini, D.J.; Marder, S.M.; Bernow, S.S. (Argonne National Lab., IL (USA)). Feb 1979. Contract W-31-109-ENG-38. 68p. P 04/MF A01.

This study considers the major urbanized areas of nine US cities to arrive at rough estimates of costs required to retrofit them with district energy systems (DES). Only those costs associated with heating and hot water are addressed here. Demand estimates and energy-supply analyses are made, and component capital costs are estimated to arrive at annualized system costs. Finally, a comparison of alternative energy-delivery options is made, and estimates of scarce-fuel savings are derived. 49 references, 20 figures, 14 tables.

53289 (PB—291441) **Guidelines for evaluation of a mius demonstration.** Grot, R.A.; Mitchell, D.J.; Schaefgen, J.R.; Chao, A.C.; Kuklewicz, M.E. (National Bureau of Standards, Washington, DC (USA). Center for Building Technology). Dec 1978. 46p. Y A03/MF A01.

This document is a guideline for the development of a detailed evaluation plant for a MIUS facility which was planned for demonstration at St. Charles, Maryland. The generic types of technical, institutional, and economic issues are discussed. General performance measures for the total system and each subsystem are indicated. The classes of data that will be required and the types of data analyses to be employed are outlined.

CONSERVATION

REFER ALSO TO CITATION(S) 53280, 53288, 53325, 53388, 53394, 53395, 53399, 53400, 53401, 53402, 53408, 53703

53290 (ANL/CNSV-TM—10) **Community energy plans and planning methodologies: a preliminary bibliography.** Meshenberg, M.J. (Argonne National Lab., IL (USA)). Jun 1979. Contract W-31-109-ENG-38. 12p. P 02/MF A01.

The first section of the bibliography is an extensive listing of plans and studies prepared by communities covering various aspects of energy management. Some are brief policy statements, and others are detailed efforts to develop prototype planning approaches being applied to a particular community situation. The second section lists manuals on comprehensive community energy management planning, not necessarily applying to actual communities.

53291 (CONF-790672—2) **Software strategies for Integrated Community Energy Systems.** Rabl, V.A.; Calm, J.M.; Roberts, J.J. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 6p. P 02/MF A01.

From International symposium on modeling, planning, and decision in energy systems; Montreux, Switzerland (19 Jun 1979).

Community systems offer energy-conserving alternative methods of meeting the energy service needs of residential, commercial, and other facilities while conserving energy and scarce fuels. This paper discusses the Integrated Community Energy Systems (ICES) approach, explores the need for computerized methods for ICES, and presents a simulation and optimization software series developed or under development for planning and design of such systems. The software addresses the analysis of community loads and energy requirements as well as the supply and distribution subsystems. Since ICES may provide several different energy services simultaneously, the overall energy conservation and economic potentials of the system are critically dependent on the match between the community demand and the supply system performance characteristics. The software has, therefore, been designed not only to simulate the system performance, but also to select optimal equipment capacities and system operation so as to minimize, at the user's choice, either the energy consumption or system costs. The ICES applications place a number of additional requirements on the software, including flexibility, modularity, ease of use, efficiency, and portability.

53292 (COO—4465-2) **Status of energy management academic programs in US institutions of higher education. Final report, Part I.** Eisenberg, L.; Daspit, C.; Shimamoto, G. (Pennsylvania Univ., Philadelphia (USA)). Sep 1978. Contract EE-77-S-02-4465. 235p. P 11/MF A01.

Energy Management is described as an interdisciplinary, problem-solving activity concerned with assessment and control of the economic, environmental, and societal effects of energy resource distribution, production, conversion, or end use. Its objective is the optimum use of energy in a socially acceptable environment. An energy-management program is considered to be a formal course of study, leading to the bachelor's or higher degree, which addresses the range of energy-management issues. To identify energy-managment programs and related courses, 2602 US institutions of higher education were surveyed. More detailed information was sought from respondents who indicated that they had, or planned to offer, such a program. Ultimately ten existing, and seven planned, programs were identified. In addition, 303 institutions were found to offer one or more couses on some aspect of energy management. The ten existing programs were classified as undergraduate, engineering-focused, or general/diversified. They were analyzed in terms of their administrative organization, enrollment and number of degrees awarded to date, availability of financial support for graduate students, program goals and curriculum design, background of pesent students, employment of graduates, and the types of problems and needs cited by program heads. Information on the planned programs, when available, was also included in this analysis.

53293 (DOE/CS—0044/1(6-79)) **State energy conservation program measure directory. Volume 8 of the sourcebook, Part 1.** (Department of Energy, Washington, DC (USA). Office of State and Local Programs). Jun 1979. 630p. P 99/MF A01.

This sourcebook contains one page for each program measure in each State Energy Conservation Plan. Selected information from the SECP Description and Data System is presented. The information included is updated through early June 1979. Part I identifies the particular program measure with respect to its state, the program under which it is funded (Base/EPCA, Supplemental/ECPA, or a combination), its code number, and its name. Part II provides an abbreviated narrative description of the program measure. Part III contains selected data items characterizing the nature and scope of the program measure. These items include up to three codes (descriptions included) identifying the energy end use sectors primarily affected by the program measure, and up to three codes identifying the foremost types of implementation strategies employed by the program measure. Also in Part III is an indication of the first calendar year and quarter in which implementation of actual energy-savings-producing activities is planned to occur and when these activities are scheduled to stop. The expenditures of the programs are identified and the capability of the measure to fulfill one of the specific program measure requirements under EPCA or ECPA is indicated. Part IV reports the estimate of actual energy savings achieved by the program measure. This volume contains information on states listed alphabetically from Alabama to Montana.

53294 (DOE/CS—0044/2(6-79)) **State energy conservation program measure directory. Volume 8 of the sourcebook, Part 2.** (Department of Energy, Washington, DC (USA). Office of State and Local Programs). Jun 1979. 594p. P 25/MF A01.

This sourcebook contains one page for each program measure in each State Energy Conservation Plan. Selected information from the SECP Description and Data System is presented. Part I identifies the particular program measure with respect to its state, the program under which it is funded, its code number, and its name. Part II provides an abbreviated narrative description of the program measure. Part III contains selected data items characterizing the nature and scope of the program measure. Part IV reports the estimate of actual energy savings achieved by the program measure. Volume 2 contains information on states listed alphabetically from Nebraska to Wyoming and Virgin Islands, Guam, American Samoa, and Puerto Rico. Two appendices are: Table of End Use Sector Codes and Cross-Reference Index by End Use Sector and Table of Implementation Strategy Codes and Cross-Reference Index by Implementation Strategy Type.

53295 (DOE/CS—0100) **Evaluation of the Energy Extension Service Pilot Program: the first year.** (Department of Energy, Washington, DC (USA). Office of State and Local Programs). Aug 1979. 16p. P 02/MF A01.

This paper presents a selective summary of the three-volume report on the evaluation of the Energy Extension Service (EES) Pilot Program published in September 1979. This paper provides the results of the pilot evaluation for program managers who are interested in the findings of the EES evaluation so that they may apply them in making program decisions themselves. This audience includes state energy office directors and their staffs, EES directors, and program managers who will be responsible for directing service delivery programs in a national EES program. Therefore, this paper aims to provide practical results for use by program managers; it does not repeat the detailed data and the statistics contained in the three-volume Energy Extension Service Evaluation Report.

53296 (DOE/CS/2671—1) **Energy Extension Service Program planning manual.** (ICF, Inc., Washington, DC (USA)). Jun 1979. Contract EX-77-C-01-2671. 345p. P 15/MF A01.

The manual is the first revision of the EES Program Planning Manual. At the states' request, there have been a number of changes to the state EES contacts list, and an updated list is included in this package as the revised Appendix D. Part I, Introduction, presents: How to Use the State Program Planning Manual and The Energy Extension Service Program. Part II, Applying for an EES Grant, presents: The Annual State Application for Financial Assistance; State Financial Assistance and Associated Requirements; Preparing the State Plan. Part III, Operating a State EES, presents: Start-Up Considerations; State Program Reporting; Recordkeeping and Financial Management. Part IV, DOE's Role, presents DOE Functions and Responsibilities and Special Cases: Development and Implementation of a State Plan by the EES Director and Administrative Review.

53297 (DOE/CS/5255—1) **Energy-efficient procurement in state and local government.** Russell, J.W. Jr. (Environmental Law Inst., Washington, DC (USA)). Jul 1979. Contract EM-78-C-01-5255. 72p. P 04/MF A01.

As the prices of domestically produced and imported energy continue to skyrocket, the need for increased efforts to save energy grows. While states and their political subdivisions can encourage energy conservation in a variety of ways, they can set an example for their citizens and save energy themselves by becoming more conscious of the energy impacts of government purchasing and more committed to energy-efficient procurement. This report examines the progress made by states in this area since the enactment in 1975 of the Energy Policy and Conservation Act (EPCA). One part of this law authorizes Federal assistance to states for the preparation and implementation of energy-conservation plans to include, among other elements, energy-efficient procurement standards and policies. Three and a half years after EPCA's passage, state and local energy-efficient procurement programs, with a few exceptions, have barely advanced beyond infancy. The major reasons for this are a lack of reliable energy-efficiency information on many energy-consuming products, a resistance to change on the part of purchasing officials or their superiors, and a reluctance in the tax-revolt era to spend money in order to save money as well as energy. To overcome these obstacles, states and localities should consider mandating energy-efficient procurement practices through either executive orders or legislation. In addition, states and localities should consider adopting institutional arrangements, such as centralized purchasing and joint or cooperative purchasing that will facilitate energy-efficient procurement. To further state and local efforts in this area, the Federal government should provide technical and financial assistance to an organization or purchasing officials to establish an information clearinghouse.

SUPPLY, DEMAND, AND FORECASTING

REFER ALSO TO CITATION(S) 52530, 52550, 53264, 53274, 53319, 53398, 53404, 53701

53298 (DOE/EIA—0076) **Motor gasoline supply and demand 1967 to 1978.** Seiferlein, K.E. (Department of Energy, Washington, DC (USA). Energy Information Administration). Aug 1978. 41p. Q 03/MF A01.

Data on motor gasoline supply and demand are presented in tables and graphs. Consumption patterns are considered.

53299 (DOE/EIA—0102/12) **Forecasts of principal petroleum product demands 1979, 1985, 1990 by DOE region and four macroeconomic/geologic scenarios.** Allen, C.; Gaynor, W.; Walton, H. (Department of Energy, Washington, DC (USA). Energy Information Administration). Aug 1978. 14p. Q 02/MF A01.

The Energy Information Administration (EIA) was requested by the Economic Regulatory Administration to provide estimates of the domestic demand for the principal refined petroleum products in 1980, 1985, and 1990 in each region of the country. This information was to be used in DOE testimony before the US Senate Subcommittee on Energy Conservation and Regulation on July 10, 1978. Tables 1 to 4 of this Analysis Memorandum present the range of domestic demand estimates for 1979, 1985, and 1990 for gasoline, distillate fuel oil, residual fuel oil, and jet fuel oil. The range was obtained by considering four macro-economic/geologic scenarios originally developed for the EIA Annual Report to Congress, Volume II, (AAR) published in April 1978. Descriptions of the pecise assumptions underlying these scenarios can be found in the AAR. Demands for 1979 were developed using the Short-Term Petroleum Product Demand (STPPDM) Model, while forecasts for 1985 and 1990 were developed by the EIA mid-range energy modeling system. All forecasts are consistent with those published in the AAR. Forecasts for 1980 are not presented because the short-term model has not been validated for that year using the scenario definitions contained in the AAR.

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 52561, 52760, 53261, 53264, 53269, 53270, 53273, 53287, 53295, 53297

53300 (DOE/PE—0015/1) **Local government energy activities. Volume 1. Summary analysis of twelve cities and counties.** (Department of Energy, Washington, DC (USA). Office of Policy and Evaluation; Department of Energy, Washington, DC (USA). Office of Intergovernmental and Institutional Relations; National Association of Counties, Washington, DC (USA); National League of Cities, Washington, DC (USA); US Conference of Mayors, Washington, DC). Jul 1979. 64p. P 04/MF A01.

At this time there is very little systematic data on what local governments are doing in energy, how they came to undertake particular activities, and what they could be doing. The Department of Energy has done this study in order to gather information on this subject to aid in making its decisions affecting local governments. This report is an early step in a policy development process involving extensive exchange with interested parties outside DOE, as well as further work on local government energy activities. The particular objectives of the study are to help DOE understand what energy activities have been undertaken by local governments; the factors influencing the choice and implementation of these activities; relationships among levels of government, and between government and the community; and barriers experienced by local governments in their energy efforts. The twelve governments selected for study are a judgmental, non-representative sample selected for their regional, climatic, economic, and social diversity. The sites are mostly in city/county pairs: Boston; Metro Dade County; Pittsburgh/Allegheny County; Seattle/King County; Oakland/Alameda County; City of Los Angeles/Los Angeles County; and Minneapolis/Hennepin County.

53301 (DOE/PE—0015/2) **Local government energy activities. Volume 2. Detailed analysis of twelve cities and counties.** (Department of Energy, Washington, DC (USA). Office of Policy and Evaluation). Jul 1979. 192p. P 09/MF A01.

The particular objectives of this study are to help DOE better understand: what energy activities have been undertaken by local governments in large urban areas; the factors influencing the choice and implementation of these activities; relationships existing between local governments, local groups, the states and the Federal government in the area of energy; barriers experienced by local governments in their energy efforts. The twelve governments in the seven sites studied are a judgmental, non-representative sample selected for their regional, climatic, economic, and social diversity. They are: Boston; Metro-Dade County, Florida; Pittsburgh/Allegheny County; Minneapolis/Hennepin County; Seattle/King County; Oakland/Alameda County; City of Los Angeles/Los Angeles County. Chapter II describes: local perceptions of energy problems; energy goals and policies; organization of energy activities; energy programs within local governments and the community; energy data collection and use; energy emergency preparedness; program monitoring and evaluation; existing relationships with other levels of government and outside institutions; ideal energy roles in the Federal system. Chapter III evaluates the findings in Chapter II.

53302 (DOE/PE—0015/3) **Local government energy activities. Volume 3. Case studies of twelve cities and counties.** (Department of Energy, Washington, DC (USA). Office of Policy and Evaluation). Jul 1979. 198p. P 09/MF A01.

The study, to provide DOE with: information on energy activities undertaken by local governments in large urban areas; factors influencing the choice and implementation of these activities; facts on relationships existing between local governments, local groups, the states, and the Federal government in the area of energy; and information on barriers experienced by local governments in their energy efforts, has been presented in additional volumes. In this volume specific information on 12 governments in seven sites are presented. Specific information on local energy situation; energy goals, policies, and plans; energy organization and intra-governmental relations; energy problems (in the community); energy programs (in house); relationships with other levels of government; and ideal roles was investigated for these areas: Boston; Pittsburgh; Allegheny County, Pennsylvania; Metro-Dade County, Florida; City of Los Angeles, California; Los Angeles County, California; Oakland, California; Alameda County, California; Seattle, Washington; King County, Washington; Minneapolis; and Hennepin County, Minnesota.

53303 (DOE/TIC—10203) **National Energy Plan II.** (Department of Energy, Washington, DC (USA)). May 1979. 185p. P 09/MF A01.

This is one of a series of reports on the Nation's energy policies and programs required by a variety of legislative mandates. Initially, 7 chapters are given: Crisis and Uncertainty in the World Energy Future; The US Energy Future: The Implications for Policy; Conservation; Oil and Gas; Coal and Nuclear Power; Solar and Other Inexhaustible Energy Sources; and Making Decisions Promptly and Fairly. Chapter VIII, NEP-II and the Future, discusses the second National Energy Plan. It sets forth three basic principles for an effective national energy strategy: the nation must reduce its dependence on foreign oil and its vulnerability to supply interruptions; in the mid-term, the two objectives of policy are to keep US imports sufficiently low to protect US security and to extend the period before world oil production reaches its limits of production capacity, and to develop the capability to use new backstop technologies as world oil prices rise; and for the long-term, the objective of US energy policy is to have renewable and essentially inexhaustible sources of energy available to sustain a healthy economy. The second National Energy Plan proposes new measures

that build on the accomplishments of last year's National Energy Act.

53304 (PB—292155) **U.s. ocean policy in the 1970s: Status and issues.** (National Oceanic and Atmospheric Administration, Washington, DC (USA)). Oct 1978. 336p. Y A15/MF A01.

This report discusses current ocean policies in each major area of civilian ocean and coastal affairs, provides background information on the evolution of policies, describes and appraises the status of Federal ocean programs, identifies issues that need to be resolved, and reviews recommendations that have been made by various advisory commissions, councils, and other groups, including legislative proposals where appropriate. Some of the principal issues discussed are: fisheries, coastal resources, wetlands, siting electric power plants, recreation, hazards, mining, marine transportation, education, and marine science and technology.

53305 (PB—292291) **U.S. ocean Policy in the 1970s: Status and issues. policy overview.** (National Oceanic and Atmospheric Administration, Washington, DC (USA)). Oct 1978. 58p. Y A04/MF A01.

The study that is highlighted in this summary, U.S. Ocean Policy in the 1970s: Status and Issues, is the result of the first extensive review of national ocean affairs since 1969. The contents of this study consider the Nation's overall stake in its ocean and coastal resources and review the status of the six major elements of U.S. ocean policy: marine fisheries; coastal resources; the marine environment; marine science and technology; marine transportation; and marine employment, education, and training. The study also considered the organizational structure that is employed by the Federal Government in carrying out the national ocean effort.

53306 **What's really new about policy modeling. Assessment on the basis of the US Federal Government experience.** House, P. (Dept. of Energy, Washington, DC). *J. Policy Model.;* **1**: No. 2, 159-178(May 1979).

This article is an attempt to look at where policy modeling is today in reality as opposed to where it is often perceived to be by those who are its proponents. To do this, an impressionistic survey is made of the state of the art, looking at such factors as model theory, structure, data, validation, and uses. Finally, some effort is made to take the results of this examination and use the conclusions reached to suggest what the future of policy modeling might be and what yet unexplored avenues remain to the model builders and users. 31 references.

53307 **Role of the Federal Energy Regulatory Commission.** Sheldon, G. (Federal Energy Regulatory Commission, Washington, DC). *Proc. Am. Power Conf.;* **40**: 23-28(1978). (CONF-780440—).

From American power conference; Chicago, IL, USA (Apr 1978).

The Federal Energy Regulatory Commission exists as an independent regulatory agency within the Department of Energy. It is not subject to the supervision or direction of an official of the Department of Energy. The Federal Energy Regulatory Commission inherited most of its regulatory responsibilities from the old Federal Power Commission, which had the responsibility of establishing just and reasonable rates for the sale of natural gas and electric power, along with issuing certificates and licenses for the construction and operation of natural gas pipelines and hydroelectric plants. The author outlines improvements to the decision-making system of the Federal Energy Regulatory Commission. Issuance of rulemakings as prime vehicles for deciding generic issues is one approach to streamlining the Commission's handling of some cases.

FOSSIL FUELS

REFER ALSO TO CITATION(S) 53326, 53404

COAL

REFER ALSO TO CITATION(S) 52420, 52513, 52516, 52530, 53145

53308 (RLO—1002-T2(Vol.1)) **Alaska Regional Energy Resources Planning Project, Phase 2: coal, hydroelectric, and energy alternatives. Volume I. Beluga Coal District analysis.** (Alaska Dept. of Commerce and Economic Development, Juneau (USA)). Jan 1979. Contract EY-77-C-06-1002. 452p. P 20/MF A01.

The Alaska Regional Energy Resources Planning Project is presented in three volumes. This volume, Vol. I, analyzes the development of the Beluga coal fields, dealing with the problems and procedures inherent in the development of a coal field. Following these introductory remarks, it is noted that Chapter II, Social Effects and Management Alternatives, has been submitted to the Department of Energy and will be included in the final report. Chapter III and the following chapters cover: Beluga coal field licenses and permits, land tenure, coal technology, transportation of coal, and environmental assessment of the Beluga coal field. (MCW)

PETROLEUM

REFER ALSO TO CITATION(S) 52549, 52550, 52553, 52554, 52556, 52561, 52564, 53298, 53299

53309 (DOE/EIA—0012(77-78)) **Report on sales of refined petroleum products.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Nov 1977. 242p. Q 11/MF A01.

Petroleum market shares is a continuing series of monitored monthly changes in the refinery sales distribution and the retail market shares of selected petroleum products. The period covered is July 1977 through May 1978.

53310 (DOE/EIA—0043/78-1) **Preliminary gasoline prices: January 1978 through June 1978.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 1978. 17p. Q 02/MF A01.

Monthly statistics on the average gasoline retail dealer buying and selling prices by Department of Energy regions are presented for the first six months of 1978.

53311 (DOE/EIA—0105(77-78)) **Availability of heavy fuel oils by sulfur levels, May 1977 through May 1978.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 1978. 185p. Q 09/MF A01.

Monthly statistics on the availability of heavy fuel oils by sulfur levels are given for May 1977 through May 1978.

53312 (DOE/EIA—0107(77)) **Crude-oil and refined-products pipeline mileage in the United States, January 1, 1977.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Dec 1977. 8p. Q 02/MF A01.

This report contains the following tables: mileage of petroleum pipelines in the United States (1926 to 1977); mileage of petroleum pipelines in the United States, January 1, 1977 and January 1, 1974; petroleum pipelining activity in the United States, January 1, 1974 to January 1, 1977; mileage of gathering lines in the United States as of January 1, 1977; mileage of product pipelines in the United States as of January 1, 1977; mileage of crude trunklines in the United States as of January 1, 1977; and pipeline fill for petroleum pipelines in the United States January 1, 1977 and January 1, 1974.

53313 (DOE/EIA—0108(76)) **Crude petroleum, petroleum products, and natural gas liquids: 1976 (final summary).** (Department of Energy, Washington, DC (USA). Energy Information Administration). Jan 1978. 42p. Q 03/MF A01.

Production of crude petroleum (including lease condensate) in the United States in 1976 averaged 8,132,000 barrels per day, a decrease of 243,000 barrels per day, or 2.9% below the 1975 level, reports the Energy Information Administration, United States Department of Energy. Imports of crude oil in 1976 averaged 5,287,000 barrels per day, 28.8% higher than a year ago. Of the total crude oil imported in 1976, 4,545,000 barrels per day, or 86.0% of the total, came from OPEC countries. Stocks of crude oil, both domestic and foreign, totaled 285,471,000 barrels at the end of 1976, 14.1 million barrels above the 1975 year-end level. The average value of crude oil at the wellhead in 1976 was $8.14 per barrel, an increase of $.58 per barrel above the 1975 average price. The number of oil wells completed in 1976 totaled 17,059 compared with 16,408 in 1975. Production of products at natural gas processing plants during 1976 totaled 1,604,000 barrels per day compared with 1,633,000 barrels per day for 1975. Total disposition of primary supply of all oils in 1976 averaged 17,698,000 barrels per day, including domestic product demand of 17,461,000 barrels per day, refined products exports of 215,000 barrels per day, crude oil exports of 8,000 barrels per day and crude losses of 14,000 per day. Domestic demand for major products in 1976 showed daily average gains of 4.5% for gasoline, 9.9% for distillate fuel oil, and 13.8% for residual fuel oil, while the domestic demand for jet fuel declined by 1.4%. Crude oil input to refineries rose in 1976 to 13,416,000 barrels per day. Refined products stocks at the end of 1976 totaled 707,723,000 barrels, reflecting a stock decrease of 40.1 million barrels during the year.

53314 (DOE/EIA—0109(77-78)) **Crude petroleum, petroleum products, and natural gas liquids, July 1977 through May 1978.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 1978. 154p. Q 14/MF A01.

Data on crude petroleum, petroleum products, and natural gas liquids are presented in tabular form for the period July 1977 through May 1978.

53315 (DOE/EIA—0115/77) **Supply, demand, and stocks of all oils by P.A.D. districts and imports into the United States, by country.** (Department of Energy, Washington, DC (USA). Energy Information Administration). May 1978. 20p. Q 02/MF A01.

Supply, demand, and stocks of all oils by P.A.D. Districts and imports into the United States by country are presented for 1977.

53316 (DOE/EIA—0116/2(77)) **Supply, demand, and stocks of all oils by P.A.D. districts and imports into the United States, by country.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Dec 1977. 29p. Q 03/MF A01.

Supply, demand, and stocks of all oils by P.A.D. Districts and imports into the United States by country are given for the last three quarters of 1977 and the first quarter of 1978.

53317 **Some long-term problems in OPEC oil pricing.** Pindyck, R.S. (Massachusetts Inst. of Tech., Cambridge). *J. Energy Dev.;* **4**: No. 2, 259-272(Spr 1979).

Economic maximization is shown to reasonably explain the oil-pricing policies of the Organization of Petroleum Exporting Countries (OPEC). A model is described which can be used to calculate optimal OPEC pricing policies that will maximize present and future discounted profits on the basis of world supply and demand. The real price of oil, using this method, should have only a nominal rate of increase in the short-term, but the allocation of production cutbacks and the threat of large-scale Mexican production could affect OPEC's monopoly price over the long-term. Pricing policies are analyzed using scenarios which reflect these problem areas. Several policy directions for the US are suggested that would lessen US vulnerability to OPEC actions.

53318 **Capital investments of the world petroleum industry, 1977.** Dobias, R.S.; Sparling, R.C. New York, NY; Chase Manhattan Bank (1978). 20p.

Figures are given on capital and exploration expenditures, capital spending by function, gross and net investment, and expenditures by country and region. (DLC)

NATURAL GAS

REFER ALSO TO CITATION(S) 52555, 52568, 53313, 53314

53319 (DOE/EIA—0042(76)) **Internationa Petroleum Annual 1976.** Southard, L.G.; Homer, A.L. (Department of Energy, Washington, DC (USA). Energy Information Administration). Jun 1978. 38p. Q 03/MF A01.

The International Petroleum Annual contains data on supply of and demand for crude petroleum and refined products; output of refined products; imports of refined products; exports and reexports of refined products; domestic demand for refined products; world crude oil production; world crude reserves; producing wells, number and capacity of refineries; retail prices of selected petroleum products; production of natural gas plant liquids; and conversion factors.

53320 (DOE/EIA—0047(77-78)) **EIA reports average gas prices for June 1977 up from same, June 1977 through May 1978.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 1978. 61p. Q 04/MF A01.

Monthly statistics on interstate gas prices and financial data are given for the period June 1977 through May 1978.

53321 (DOE/EIA—0066(78)) **Petroleum market shares.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Jul 1977. 90p. Q 05/MF A01.

Petroleum Market Shares is a monthly series of reports that monitors changes in the aggregate market shares of motor gasoline retailers. The independent marketer data used are based on a continuing survey of gasoline service stations conducted by the Bureau of Census. The survey obtains data on the number of gallons sold by approximately 10,000 sample stations each month. This information is used to develop universe estimates of market shares as required by Section 4(c)(2)(A) of the Emergency Petroleum Allocation Act of 1973 for nonbranded marketers and branded independent marketers. The time period covered is July 1977 through April 1978.

53322 (DOE/EIA—0129/76) **Main line natural gas sales to industrial users: 1976.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Feb 1978. 73p. Q 04/MF A01.

Main line natural gas sales to industrial users by state and type of sale (1976), by SIC codes (1972 to 1976), by states and SIC codes (1972 to 1976), by natural gas companies and SIC codes (1972 to 1976), and by state (1972 to 1976), are presented in tabular form.

53323 (DOE/EIA—0130)77-78)) **Marketed production, imports and exports of natural gas: July 1977 through May 1978.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 1978. 11p. Q 02/MF A01.

Monthly statistics by State are presented on marketed production, imports, and exports of natural gas for the period July 1977 through May 1978.

53324 (DOE/EIA—0131(76)) **Natural gas production and consumption: 1976.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 7 Feb 1978. 12p. Q 02/MF A01.

Data are presented in tabular form on the salient statistics of natural gas in the United States (1972 to 1976); gross withdrawals and disposition of natural gas in the United States (1975 to 1976); quantity and value of marketed production of natural gas in the United States (1975 to 1976); marketed production, interstate shipments and total consumption of natural gas in the United States (1976); production of natural gas liquids at natural gas processing plants, natural gas processed, and extraction loss in 1975 and 1976; consumption of natural gas by use and by state (1976); natural gas input to and output from storage in 1976; underground storage capacity by state, December 31, 1976; producing gas and condensate wells in the US; and estimated total proved reserves of natural gas in the US (1976).

53325 **Research activities in the United States on energy conservation in the gas inndustry.** Huebler, J.; Macriss, R.A. (eds.). Chicago, IL; Institute of Gas Technology (1979). 57p. (CONF-790512—3).

From 14. world gas conference; Toronto, Canada (27 May 1979).

The paper describes the content and progress of the Space Heating Equipment Improvement Program, which seeks to define those areas where efficiency improvement can most readily be attained. The goals of the newly formed Gas Research Institute (GRI) are listed. GRI has supplanted the former American Gas Association research program. In improvement of residential and commmercial space heating equipment, three specific programs are described: (1) developing a furnace employing a pulse-combustion burner system (currently being tested); (2) determining heat losses from duct systems, which have shown that these losses contribute to an important and avoidable loss in efficiency; (3) measuring heat losses in a large number of installed furnaces, which are under way to verify (and modify if required) IGT's model of flue heat losses. Two appliance improvement programs are described in which a new concept for a water heater and an intermittent ignition device are being developed. In the area of heat-actuated heat pumps, the paper describes programs to bring one or more of the available devices to the marketplace. These developments involve the free-piston Stirling engine, the gas turbine (Brayton cycle), an absorption machine, and reversible vapor-compression-cycle heat pump. Technologies that are of great interest for future application are represented by development of fuel-cell systems and gas-augmented, solar devices. Some technology needed to achieve greater conservation in industry is considered. Examples of cogeneration in a glass-melting furnace and flue-gas pressurization to recover heat in metal-treating furnaces are used. The rapidly growing efforts supported by DOE and GRI in the industrial area are described.

HYDROGEN AND SYNTHETIC FUELS

53326 **Realities of the energy problem today and options for tomorrow.** O'Leary, J.F. (Department of Energy, Washington, DC). *Proc. Am. Power Conf.;* **40**: 3-12(1978). (CONF-780440—).

From American power conference; Chicago, IL, USA (Apr 1978).

This speech can be divided into two central themes - synthetic fuels commercialization and nuclear energy. The present fuel conversion programs were reviewed to establish the feasibility of commercialization. The liquid-burning utilities believe a shortfall in availability by 1990 will necessitate a 2 to 3 million barrel per day synthetic fuel capacity. Presently the SRC-2 coal-to-gas liquids program and the SRC-1 coal-to-solids program have an excellent chance to get commitments to build 20,000 barrels-a-day plants. Dwindling resources of domestically produced oil and gas were discussed. The author felt that where deregulation was not applied, taxes should be imposed to bring prices in line with world market prices. Next the author turned to the second theme - nuclear power. He outlined the lack of real education of the public to the risks associated with nuclear power compared to other energy sources. He indicated that unless the conference attendees ranked nuclear energy among their first priorities, the nuclear option would be unachievable.

ELECTRIC POWER

REFER ALSO TO CITATION(S) 52516, 52754, 52804, 53149, 53267, 53269, 53270, 53307, 53385

53327 (DOE/EIA—0016) **National Electric Rate Book: Minnesota, New York, and North Carolina.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Oct 1977. 86p. (DOE/EIA—0017; DOE/EIA—0018). Q 05/MF A01.

Rate schedules for electric service in communities of 2,500 or more for residential, commercial, and industrial services are presented for Minnesota, New York, and North Carolina. In addition to communities of 2,500 or more, all towns and villages with popula-

tions between 1,000 and 2,500 served under residential rate schedules available in the larger communities are listed. Rate schedules include customers for lighting, heating, power, and other purposes. Omitted are those applicable exclusively to resale service, railways, government bodies, agricultural, and rural service.

53328 (DOE/EIA—0019) **National Electric Rate Book: Oklahoma and Alabama.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Oct 1977. 35p. (DOE/EIA—0020). Q 02/MF A01.

Rate schedules for electric service in communities of 2,500 or more for residential, commercial, and industrial services are presented for Oklahoma and Alabama. In addition to communities of 2,500 or more, all towns and villages with populations between 1,000 and 2,500 served under residential rate schedules available in the larger communities are listed. Rate schedules include customers for lighting, heating, power, and other purposes. Omitted are those applicable exclusively to resale service, railways, government bodies, agricultural, and rural service.

53329 (DOE/EIA—0022/1) **National Electric Rate Book: Kentucky.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Oct 1977. 17p. Q 02/MF A01.

Rate schedules for electric service in communities of 2,500 or more for residential, commercial, and industrial services are presented for Kentucky. In addition to communities of 2,500 or more, all towns and villages with populations between 1,000 and 2,500 served under residential rate schedules available in the larger communities are listed. Rare schedules include customers for lighting, heating, power, and other purposes. Omitted are those applicable exclusively to resale service, railways, government bodies, agricultural, and rural service.

53330 (DOE/EIA—0024) **National Electric Rate Book: Mississippi, North Dakota, South Carolina, and South Dakota.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Oct 1977. 58p. (DOE/EIA—0025; DOE/EIA—0026; DOE/EIA—0027). Q 04/MF A01.

Rate schedules for electric service in communities of 2,500 or more for residential, commercial, and industrial services are presented for Mississippi, South Carolina, South Dakota, and North Dakota. In addition to communities of 2,500 or more, all towns and villages with populations between 1,000 and 2,500 served under residential rate schedules available in the larger communities are listed. Rate schedules include customers for lighting, heating, power, and other purposes. Omitted are those applicable exclusively to resale service, railways, government bodies, agricultural, and rural service.

53331 (DOE/EIA—0028) **National Electric Rate Book: Tennessee, Ohio, and Massachusetts.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Oct 1977. 79p. (DOE/EIA—0029; DOE/EIA—0030). Q 05/MF A01.

Rate schedules for electric service in communities of 2,500 or more for residential, commercial, and industrial services are presented for Tennessee, Ohio, and Massachusetts. In addition to communities of 2,500 or more, all towns and villages with populations between 1,000 and 2,500 served under residential rate schedules available in the larger communities are listed. Rate schedules include customers for lighting, heating, power, and other purposes. Omitted are those applicable exclusively to resale service, railways, government bodies, agricultural, and rural service.

53332 (DOE/EIA—0033/1) **Steam—electric plant construction cost and annual production expenses 1975. Twenty-eighth annual supplement.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Jan 1978. 246p. (CRN—780106-00011). P 11/MF A01.

The 1975 supplement contains data for 621 conventional fossil-fueled steam—electric plants in the contiguous US, four in Hawaii, one in Alaska, and four in Puerto Rico. In addition, data on 38 nuclear-fueled steam—electric plants are reported in this supplement. Fourteen new fossil-fueled plants are reported for the first time. One fossil-fueled plant and one nuclear plant reported in prior supplements were omitted from this supplement. The 626 plants located in the US accounted for 99% of the capacity and 97% of the generation of utility-owned, fossil-fueled steam—electric plants in the US. At mid-1977, 252 new fossil-fueled units 300 MW and larger and totaling 145,002 MW were in preliminary test, under construction, or scheduled to start construction, for service between 1977 and 1986. Projected nuclear capacity as of the first half of 1977, for service during the period 1977 through 1986, was 130,532 MW in 121 units. Projected fossil-steam and nuclear-generating capacity additions for the 1976 through 1985 period were revised downward from the previous projection covering the 1975 through 1984 period. Recession-related financing problems and reduction in load growth during 1975 and 1976 forced a revision downward in projected capacity additions for the period 1976 through 1985. These same problems were the main reason for just a minimal increase in the amount of new capacity projections for the 1977 through 1986 period. Currently installed fossil-fueled and nuclear-fueled steam—electric capacity is 393,169 MW. The annual retirements of steam—electric generating capacity for the years 1951 to 1975 are shown.

53333 (DOE/EIA—0053) **National Electric Rate Book: Alaska, Indiana, and Illinois.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Apr 1978. 68p. (DOE/EIA—0054; DOE/EIA—0055). Q 04/MF A01.

Rate schedules for electric service in communities of 2,500 or more for residential, commercial, and industrial services are presented for Alaska, Indiana, and Illinois. In addition to communities of 2,500 or more, all towns and villages with populations between 1,000 and 2,500 served under residential rate schedules available in the larger communities are listed. Rate schedules include customers for lighting, heating, power, and other purposes. Omitted are those applicable exclusively to resale service, railways, government bodies, agricultural, and rural service.

53334 (DOE/EIA—0056/1) **National Electric Rate Book: Pennsylvania.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Apr 1978. 34p. Q 03/MF A01.

Rate schedules for electric service in communities of 2,500 or more for residential, commercial, and industrial services are presented for Pennsylvania. In addition to communities of 2,500 or more, all towns and villages with populations between 1,000 and 2,500 served under residential rate schedules available in the larger communities are listed. Rate schedules include customers for lighting, heating, power, and other purposes. Omitted are those applicable exclusively to resale service, railways, government bodies, agricultural, and rural service.

53335 (DOE/EIA—0060) **National Electric Rate Book: Idaho, Michigan, Nebraska, and New Mexico.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Apr 1978. 76p. (DOE/EIA—0061; DOE/EIA—0062; DOE/EIA—0063). Q 05/MF A01.

Rate schedules for electric service in communities of 2,500 or more for residential, commercial, and industrial services are presented for Idaho, Michigan, Nebraska, and New Mexico. In addition to communities of 2,500 or more, all towns and villages with populations between 1,000 and 2,500 served under residential rate schedules available in the larger communities are listed. Rate schedules include customers for lighting, heating, power, and other purposes. Omitted are those applicable exclusively to resale service, railways, government bodies, agricultural, and rural service.

53336 (DOE/EIA—0068) **National Electric Rate Book: Missouri and Texas.** (Department of Energy, Washington, DC (USA). Energy Information Administration). May 1978. 89p. (DOE/EIA—0069). Q 05/MF A01.

Rate schedules for electric service in communities of 2,500 or more for residential, commercial, and industrial services are presented for Missouri and Texas. In addition to communities of 2,500 or more, all towns and villages with populations between 1,000 and 2,500 served under residential rate schedules available in the larger communities are listed. Rate schedules include customers for lighting, heating, power, and other purposes. Omitted are those applicable exclusively to resale service, railways, government bodies, agricultural, and rural service.

53337 (DOE/EIA—0070) **National Electric Rate Book: Iowa, Nevada, New Hampsire, and Utah.** (Department of Energy, Washington, DC (USA). Energy Information Administration). May 1978. 59p. (DOE/EIA—0071; DOE/EIA—0072; DOE/EIA—0073). Q 04/MF A01.

Rate schedules for electric service in communities of 2,500 or more for residential, commercial, and industrial services are presented for Iowa, Nevada, New Hampshire, and Utah. In addition to communities of 2,500 or more, all towns and villages with populations between 1,000 and 2,500 served under residential rate schedules available in the larger communities are listed. Rate schedules include customers for lighting, heating, power, and other purposes. Omitted are those applicable exclusively to resale service, railways, government bodies, agricultural, and rural service.

53338 (DOE/EIA—0074) **National Electric Rate Book: Kansas.** (Department of Energy, Washington, DC (USA). Energy Information Administration). May 1978. 29p. Q 03/MF A01.

Rate schedules for electric service in communities of 2,500 or more for residential, commercial, and industrial services are presented for Kansas. In addition to communities of 2,500 or more, all towns and villages with populations between 1,000 and 2,500 served under residential rate schedules available in the larger communities are listed. Rate schedules include customers for lighting, heating, power, and other purposes. Omitted are those applicable exclusively to resale service, railways, government bodies, agricultural, and rural service.

53339 (DOE/EIA—0081) **National Electric Rate Book: West Virginia, Wisconsin, Hawaii, and Louisiana.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Jun 1978. 68p. (DOE/EIA—0082; DOE/EIA—0083; DOE/EIA—0084). Q 04/MF A01.

Rate schedules for electric service in communities of 2,500 or more for residential, commercial, and industrial services are presented for West Virginia, Wisconsin, Hawaii, and Louisiana. In addition to communities of 2,500 or more, all towns and villages with populations between 1,000 and 2,500 served under residential rate schedules available in the larger communities are listed. Rate schedules include customers for lighting, heating, power, and other purposes. Omitted are those applicable exclusively to resale service, railways, government bodies, agricultural, and rural service.

53340 (DOE/EIA—0085) **National Electric Rate Book: Oregon, Vermont, and Virginia.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Aug 1978. 37p. (DOE/EIA—0086; DOE/EIA—0087). Q 03/MF A01.

Rate schedules for electric service in communities of 2,500 population or more for residential, commercial, and industrial services are presented for Oregon, Vermont, and Virginia. In addition to communities of 2,500 or more, all towns and villages with populations between 1,000 and 2,500 served under residential rate schedules available in the larger communities are listed. Rate schedules include customers for lighting, heating, power, and other purposes. Rate schedules omitted are those applicable exclusively to resale service, railways, government bodies, agricultural, and rural service.

53341 (DOE/EIA—0089) **National Electric Rate Book: Arizona, California, Connecticut, and Florida.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Aug 1978. 70p. (DOE/EIA—0090; DOE/EIA—0091; DOE/EIA—0092). Q 04/MF A01.

Rate schedules for electric service in communities of 2,500 or more for residential, commercial, and industrial services are presented for Arizona, California, Connecticut, and Florida. In addition to communities of 2,500 or more, all towns and villages with populations between 1,000 and 2,500 served under residential rate schedules available in the larger communities are listed. Rate schedules include customers for lighting, heating, power, and other purposes. Omitted are those applicable exclusively to resale service, railways, government bodies, agricultural, and rural service.

53342 (DOE/EIA—0093) **National Electric Rate Book: Rhode Island.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Aug 1978. 7p. Q 02/MF A01.

Rate schedules for electric service in communities of 2,500 or more for residential, commercial, and industrial services are presented for Rhode Island. In addition to communities of 2,500 or more, all towns and villages with populations between 1,000 and 2,500 served under residential rate schedules available in the larger communities are listed. Rate schedules include customers for lighting, heating, power, and other purposes. Omitted are those applicable exclusively to resale service, railways, government bodies, agricultural, and rural service.

53343 (DOE/EIA—0098) **National Electric Rate Book: Arkansas, Maryland, District of Columbia, and Delaware.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Jul 1978. 40p. (DOE/EIA—0099; DOE/EIA—0100). Q 03/MF A01.

Rate schedules for electric service in communities of 2,500 or more for residential, commercial, and industrial services are presented for Arkansas, Delaware, Maryland, and the District of Columbia. In addition to communities of 2,500 or more, all towns and villages with populations between 1,000 and 2,500 served under residential rate schedules available in the larger communities are listed. Rate schedules include customers for lighting, heating, power, and other purposes. Omitted are those applicable exclusively to resale service, railways, government bodies, agricultural, and rural services.

53344 (DOE/EIA—0101) **National Electric Rate Book: Maine.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Jul 1978. 11p. Q 02/MF A01.

Rate schedules for electric service in communities of 2,500 or more for residential, commercial, and industrial services are presented for Maine. In addition to communities of 2,500 or more, all towns and villages with populations between 1,000 and 2,500 served under residential rate schedules available in the larger communities are listed. Rate schedules include customers for lighting, heating, power, and other purposes. Omitted are those applicable exclusively to resale service, railways, government bodies, agricultural, and rural services.

53345 (DOE/EIA—0104) **National Electric Rate Book: Wyoming.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Jul 1978. 12p. Q 02/MF A01.

Rate schedules for electric service in communities of 2,500 or more for residential, commercial, and industrial services are presented for Wyoming. In addition to communities of 2,500 or more, all towns and villages with populations between 1,000 and 2,500 served under residential rate schedules available in the larger communities are listed. Rate schedules include customers for lighting, heating, power, and other purposes. Omitted are those applicable exclusively to resale service, railways, government bodies, agricultural, and rural service.

53346 (DOE/EIA—0110(78)) **National Electric Rate Book: New Jersey.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Aug 1978. 12p. Q 02/MF A01.

Rate schedules for electric service in communities of 2,500 or more for residential, commercial, and industrial services are presented for New Jersey. In addition to communities of 2,500 or more, all towns and villages with populations between 1,000 and 2,500 served under residential rate schedules available in the larger communities are listed. Rate schedules include customers for lighting, heating, power, and other purposes. Omitted are those applicable exclusively to resale service, railways, government bodies, agricultural, and rural service.

53347 (MTR—7193) **Proceedings of workshop on the evolving structure of the electric utility industry.** (Mitre Corp., McLean, VA (USA). METREK Div.). Mar 1977. 476p. (CONF-7603129—).

From Workshop on the evolving structure of the electric utility industry; McLean, VA, USA (9 Mar 1978).

A separate abstract was prepared for 16 papers presented at the workshop, including one abstract on remarks made by 4 separate authors on anticipated trends in industry size, structure, and ownership.

53348 **Electric power in the United States: models and policy analysis.** Baughman, M.L.; Joskow, P.L.; Kamat, D.P. Cambridge, MA; Massachusetts Institute of Technology Press (1979). 276p. $29.95.

The electric power industry is a major consumer of fossil fuels and a major supplier of energy for residential, commercial, and industrial use. An understanding of the behavior and performance of this complex industry is critical if energy analysts, policymakers, and industry managers are to evaluate the ultimate effects of almost all energy policy initiatives in the not-so-distant future. This book describes a unique engineering-economic model, the Regionalized Electricity Model (REM), developed at MIT and at the University of Texas, and examines the effects that a wide range of energy policies simulated in the model would have on the demand and supply of electricity and on the utilization of fuels by the electric power industry to the year 2000. Electric Power in the United States examines such aspects of the industry's behavior and performance as how consumers choose among energy alternatives - including electricity - how the electric utility industry chooses among the different fuels that can be used to generate electricity, and how the industry determines future building of new capacity, how public utility price regulation determines electricity prices and the industry's ability to raise sufficient capital for building generating, transmission, and distribution facilities that will match supply and demand efficiently. The book discusses a range of possible futures arising from the impact of different economic events and public policies on the industry.

53349 **Proceedings of the American power conference. Volume 40.** Haigh, B. (ed.). Chicago, IL; Illinois Inst. of Technology (1978). 1550p. (CONF-780440—). $30.00.

From American power conference; Chicago, IL, USA (Apr 1978).

This proceedings includes 171 individual presentations, of which 154 were selected for the DOE Energy Data Base: two items were processed earlier and 30 were selected for Energy Abstracts for Policy Analysis (EAPA).

53350 **Energy scene: one man's perspective.** Balzhiser, R.E. (Electric Power Research Inst., Palo Alto, CA). *Proc. Am. Power Conf.;* **40**: 29-36(1978). (CONF-780440—).

From American power conference; Chicago, IL, USA (Apr 1978).

The Electric Power Research Institute (EPRI), established by the utility industry, has a $200 million budget this year. Since EPRI does not do in-house research, two-thirds of its funds go to manufacturers and suppliers, organizations that can both develop and deliver technology to the utilities and their customers. Presently fossil fuels are being looked at very carefully by EPRI. Concern is expressed that as additional coal-fired plants are required, increasingly stringent environmental requirements will create difficulties for the utilities. Coal and nuclear fuels are looked upon as the primary electric power fuels in the future.

ELECTRIC POWER GENERATION

53351 (RLO—1002-T2(Vol.2)) **Alaska Regional Energy Resources Planning Project, Phase 2: coal, hydroelectric, and energy alternatives. Volume II. Hydroelectric development.** (Alaska Dept. of Commerce and Economic Development, Juneau (USA)). Jan 1979. Contract EY-77-C-06-1002. 246p. P 11/MF A01.

The Alaska Regional Energy Resources Planning Project is presented in three volumes. This volume, Vol. II, deals with the construction and operation of a hydroelectric facility in Alaska. The Alaska Water Study Committee estimates that, from 600 identified possible development sites, the 76 primary potential hydro sites represent a potential for approximately 32,000 MW and 170 billion kWh annual energy; by contrast, the developed hydroelectric capacity totals only 131 MW. A table lists eight Alaskan communities - Barrow, Kotzebue, Bethel, Nome, Kodiak, Cordova, Petersburg, and Wrangell - in the mid-range size with populations from 2,000 to 5,000 and shows their respective potential hydroelectric sites. Following these summary profiles in this introductory chapter, Chapter 8, the following chapters are presented: Restrictions and Requirements Affecting the Construction of a Hydroelectric Facility; Hydroelectric Technology; and Environmental Impact of Hydroelectric Development. Much additional information such as resource inventories, information on designs, and bibliographies is included. (MCW)

53352 **Is smaller better.** Ford, A. (Los Alamos Scientific Lab., NM). *Public Power;* **37**: No. 4, 28-31(Jul 1979).

A hypothetical power project was designed for southeastern Utah to test whether larger centralized power plants have economic and environmental advantages over several small units. The trend toward large plants was based on the lower unit capital costs, an advantage which has been diminishing in recent years. Several 500-megawatt plants are calculated to provide lower-cost electricity, create fewer problems for the utilities, and reduce the environmental impact when compared to a single 3000-megawatt plant. It is recommended that impact statements include a discussion of the small-plants option as well as comparing site options.

ELECTRIC POWER TRANSMISSION AND DISTRIBUTION

REFER ALSO TO CITATION(S) 53150

CONSUMPTION AND UTILIZATION

REFER ALSO TO CITATION(S) 53395, 53396, 53400, 53401, 53402, 53406

UNCONVENTIONAL SOURCES AND POWER GENERATION

REFER ALSO TO CITATION(S) 52804

53353 (RLO—1002-T2(Vol.3)) **Alaska Regional Energy Resources Planning Project, Phase 2: coal, hydroelectric, and energy alternatives. Volume III. Alaska's alternative energies and regional assessment inventory update.** (Alaska Dept. of Commerce and Economic Development, Juneau (USA)). Jan 1979. Contract EY-77-C-06-1002. 326p. P 15/MF A01.

The Alaska Regional Energy Resources Planning Project is presented in three volumes. This volume, Vol. III, considers alternative energies and the regional assessment inventory update. The introductory chapter, Chapter 12, examines the historical background, current technological status, environmental impact, applicability to Alaska, and siting considerations for a number of alternative systems. All of the systems considered use or could use renewable energy resources. The chapters that follow are entitled: Very Small Hydropower (about 12 kW or less for rural and remote villages); Low-Temperature Geothermal Space Heating; Wind; Fuel Cells; Siting Criteria and Preliminary Screening of Communities for Alternate Energy Use; Wood Residues; Waste Heat; and Regional Assessment Invntory Update. (MCW)

SOLAR

REFER ALSO TO CITATION(S) 52753, 52754, 52759, 52760, 52761, 52762, 52763, 52764, 52765, 52766, 52767, 52768, 52769, 52771, 52785, 52805, 52870, 52871, 52872, 52873, 52884, 52905, 52907, 52912, 52916, 52919, 52945, 52947

53354 (TID—29408) **Evaluation of a technology assessment. An analysis of the Stanford Research Institute's solar energy in America's future: a preliminary assessment.** Enk, G.A.; Hornick, W.F. (Institute on Man and Science, Rensselaerville, NY (USA). Dept. of Economic and Environmental Studies). Aug 1977. Contract EX-76-C-01-2333. 174p. P 08/MF A01.

The Institute on Man and Science's (IMS) analysis of The Stanford Research Institute's (SRI) publication, Solar Energy in America's Future: A Preliminary Assessment is presented. Conducted as part of a multifaceted preliminary assessment project initiated by the Solar Energy Division of the US Energy Research and Development Administration (ERDA), the analysis focuses on the issues, variables and events which were either excluded from the SRI assessment or classified as extraneous by the principals involved in the preparation of the above-cited publication. The analysis involved the review of written materials of the project's principals (proposals, memoranda, drafts, and final reports) for the purpose of identifying issues of importance which were either implicitly or explicitly excluded from the project and its final publication. The purpose of the analysis, as stated in the task order from ERDA, was to identify the sensitivity or importance of excluded variables and issues, to provide the Division of Solar Energy with an analytical statement of the SRI study's utility in decision making, and to present recommendations concerning possible applications of the study.

53355 (TID—29408/1) **Evaluation of a technology assessment. An analysis of the Stanford Research Institute's solar energy in America's future: a preliminary assessment. Synopsis.** Enk, G.A.; Hornick, W.F. (Institute on Man and Science, Rensselaerville, NY (USA). Dept. of Economic and Environmental Studies). Aug 1977. Contract EX-76-C-01-2333. 31p. P 03/MF A01.

A synopsis of The Institute on Man and Science's (IMS) analysis of The Stanford Research Institute's (SRI) publication, Solar Energy in America's Future: A Preliminary Assessment is presented. Conducted as part of a multifaceted preliminary assessment project initiated by the Solar Energy Division of the US Energy Research and Development Administration (ERDA), the analysis focuses on the issues, variables and events which were either excluded from the SRI assessment or classified as extraneous by the principals involved in the preparation of the above-cited publication. The analysis involved the review of written materials of the project's principals (proposals, memoranda, drafts, and final reports) for the purpose of identifying issues of importance which were either implicitly or explicitly excluded from the project and its final publication. The purpose of the analysis, as stated in the task order from ERDA, was to identify the sensitivity or importance of excluded variables and issues, to provide the Division of Solar Energy with an analytical statement of the SRI study's utility in decision making, and to present recommendations concerning possible applications of the study.

53356 **Formation of local S.E.S.C.I. chapters.** Kerr, W.H. (Kent Chapter of Solar Energy Society of Canada, Inc., Chatham, Ontario). pp 5.2.1.1-5.2.1.7 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

Solar Energy Society of Canada can reach the masses only through strong, active, well-organized chapters. The life or death of S.E.S.C.I. may lie in the hands of the local chapters. This paper deals with the formation of new chapters, their growth and development. I have organized the Kent Chapter, and will outline the steps followed. Vital information was obtained re affiliation with S.E.S.C.I. - chapter applications, bylaws, organizational procedures, lists of nearby chapters, and qualified speakers.

53357 **Prospects to form a Canadian Solar Energy Research Institute (CanSERI).** Bolton, J.R. (Univ. of Western Ontario, London). pp 5.2.4.1-5.2.4.7 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

According to a recent speech by Mr. Gordon MacNabb, former Deputy Minister of Energy Mines and Resources, Canada is now a net importer of energy and this situation could well deteriorate such that by 1990 Canada could be importing as much as 40% of its energy needs. This projection, coupled with estimates that by around 1985 the world demand for oil will exceed the world capacity to produce oil, indicates that the late 1980's will see a significant energy crisis in Canada unless drastic measures are taken now. These measures must include stringent conservation, development of alternative fossil fuel resources (coal, heavy oil, tar sands oil) for the short tern, nuclear energy where appropriate and particularly renewable energy sources for the long term. It is in the matter of how best to develop renewable energy resources that this paper is addressed.

GEOTHERMAL

REFER ALSO TO CITATION(S) 53702

OTHER

REFER ALSO TO CITATION(S) 52728, 53120, 53121, 53280, 53281, 53413

53358 (ANL/CNSV-TM—5, pp 3-9) **Resource recovery technology state-of-the art summary.** Humber, J.N. Jun 1979.

In Proceedings: energy from urban wastes workshop, Washington, DC, September 11-12, 1978.

Information on various systems for burning solid wastes as a source of energy is summarized in several tables. Although solid waste incineration is not a new idea, these new techniques are making resource recovepy increasingly attractive to communities. Comparisons are made between the heating values of solid fuels and conventional fuels. A status report traces the history of resource recovery in the US and Europe and compares the financing costs at several US locations. (DCK)

53359 (ANL/CNSV-TM—5, pp 11-17) **Resource recovery systems: markets, products and technologies.** Gershman, H. Jun 1979.

In Proceedings: energy from urban wastes workshop, Washington, DC, September 11-12, 1978.

An overview is given of the planning and procedures necessary for starting a resource recovery project. This includes establishing a reason for the project, examining the different technologies on the market, and comparing the vendors. A range of technologies is available, with the best selection reflecting the purpose determined for the end product. Data is presented which summarizes several resource recovery technologies in terms of costs, fuel values, and experiences in marketing energy products. Trends are noted toward the incorporation of materials recovery systems in new plants, a combination of private operation and public financing, and a gradual shift to small projects.

53360 (NP—23834) **Current awareness bulletin, September—October 1978.** (National Board for Science and Technology, Dublin (Ireland)). Feb 1979. 122p. Dep. NTIS (US Sale Only), PC A06/MF A01.

This annotated bibliography covers fuel generation and premium biomass usage of animal wastes and crop residues, general utilization, fuel generation, and named systems for domestic and urban wastes; short rotation forestry, forest residue utilization, and cellulose utilization of forestry products; and general and review topics. (JSR)

ENERGY CONVERSION

MHD GENERATORS

53361 (COO—4651-11) **Review and assessments of potential environmental, health and safety impacts of MHD technology. Final draft.** (Montana State Univ., Bozeman (USA)). 1978. Contract EP-78-C-02-4651. 160p. P 08/MF A01.

The purpose of this document is to develop an environmental, health and safety (EH & S) assessment and begin a site - specific assessment of these and socio - economic impacts for the magnetohydrodynamics program of the United States Department of Energy. This assessment includes detailed scientific and technical information on the specific EH & S issues mentioned in the MHD Environmental Development Plan. A review of current literature on impact-related subjects is also included. This document addresses the coal-fired, open-cycle MHD technology and reviews and assesses potential EH & S impacts resulting from operation of commercially-installed technology.

53362 (DOE/EDP—0045) **Environmental Development Plan: magnetohydrodynamics.** (Department of Energy, Washington, DC (USA)). May 1979. 199p. P 09/MF A01.

The updated Environmental Development Plan (EDP) for DOE's MHD Program is presented. A brief summary of the environmental concerns identified in the original MHD EDP is given. MHD technology and DOE's MHD program are described and environmental concerns are identified. The environmental research that should be conducted to ensure that the environmental concerns associated with MHD are addressed and resolved are tabulated. An environmental strategy to resolve the numerous environmental concerns is developed.

53363 (MIT-EL—78-005) **Proceedings of the eighth international closed-cycle specialists' meeting.** (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Mar 1978. Contract ET-78-X-01-2975. 99p. (CONF-7705153—). P 05/MF A01.

From 8. closed-cycle specialists' meeting; Cambridge, MA, USA (19 May 1977).

Summaries are given of 13 of the 15 papers presented. The two complete papers in these proceedings were entered separately in the data base. A brief summary of the round table discussion is included. (WHK)

DESIGN AND DEVELOPMENT

REFER ALSO TO CITATION(S) 53367

53364 (FE—2613-6(Vol.2B)) **MHD-ETF Program final report, January 4, 1977—March 4, 1978. Volume 2B, Parts 3, 4, and 5. Reference design description.** (General Electric Co., Philadelphia, PA (USA). Space Div.). Mar 1978. Contract EF-77-C-01-2613. 299p. P 13/MF A01.

The ETF system configuration is a 250 MWt size, coal fired, MHD/Steam combined cycle plant. The steam turbine bottoming cycle operates with steam conditions of 3500 psia/1000°F at the exit of the steam generator. The steam is then throttled to 2400 psia/950°F to match the subcritical turbogenerator. The MHD topping cycle employs a fluidized bed gasifier/double vortex cyclone combustor subsystem which delivers plasma at a temperature of 4508°F when preheated air is supplied to the second stage combustor at 2983°F by a passively controlled, high performance, indirectly oil fired, ceramic regenerative heat exchanger subsystem. The MHD generator is a subsonic linear channel with 16% generator enthalpy extraction. The test and operating philosophy of the ETF is documented including test objectives, modes of operation, and overall operating plans. Functional specifications for components and subsystems of the ETF considered to be balance-of-plant, supportive subsystems, are presented. Also diagrams and drawings of the ETF layout and balance-of-plant subsystems are included. (WHK)

53365 (FE—2613-6(Vol.4E)) **MHD-ETF Program final report, January 4, 1977—March 4, 1978. Volume 4E. Appendices A26—A28.** (General Electric Co., Philadelphia, PA (USA). Space Div.). Mar 1978. Contract EF-77-C-01-2613. 390p. P 17/MF A01.

A cooling tower trade-off study and NO/sub x/ kinetic analysis for the MHD Experimental Test Facility (ETF) are presented. An assessment of the ETF reliability, maintainability, and availability requirements is given. Studies include MHD-ETF failure rates and estimated maintenance elapsed time outages and manhours required per failure, fault trees for ETF combined cycle operation, and failure mode effect analysis. (WHK)

PERFORMANCE AND TESTING

53366 (CONF-790640—4) **High-temperature liquid—metal MHD generator experiments.** Dunn, P.F.; Pierson, E.S.; Staffon, J.D. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 8p. P 02/MF A01.

From 18. symposium on engineering aspects of magnetohydrodynamics; Butte, MT, USA (18 Jun 1979).

Detailed data were obtained for the world's first high-temperature two-phase liquid—metal MHD generator under open-circuit conditions. Both single-phase (sodium) and two-phase (sodium and nitrogen) flows were used in the temperture range of ~ 490 to ~ 740°K. The data presented includes pressures, voltages, and slip ratios (ratio of gas velocity to liquid velocity). The two-phase pressure—gradient data were predicted well by a simplified two-phase MHD correlation that includes the effect of a pure-liquid shunt layer between the electrodes. The slip ratio is shown to decrease with increasing temperature, implying higher generator and system efficiencies; this anticipated result was a prime reason for performing these experiments.

53367 (FE—2613-6(Vol.4B)) **MHD-ETF Program final report, January 4, 1977—March 4, 1978. Volume 4B. Appendices A04—A08.** (General Electric Co., Philadelphia, PA (USA). Space Div.). Mar 1978. Contract EF-77-C-01-2613. 249p. P 11/MF A01.

This appendix to the design report for the MHD Experimental Test Facility contains detailed studies on (1) MHD generator performance and heat transfer analysis, (2) performance analysis for Faraday and diagonal channels, (3) generator performance for alternate system conditions, (4) an alternate ETF system with two-stage cyclone combustor, and (5) ETF system options. (WHK)

53368 (MIT-EL—78-005, pp 11-37) **MIT disk generator with swirl.** Loubsky, J.K.; Lytle, J.K.; Louis, J.F. (MIT Energy Lab., Cambridge, MA). Mar 1978.

From 8. closed-cycle specialists' meeting; Cambridge, MA, USA (19 May 1977).

The advantages of the disk geometry over more conventional linear generators are numerous. Serious plasma and material limitations associated with the multiple electrodes of linear devices are eliminated. Since the disk is made of only two insulating walls, higher electric fields can be sustained and greater power densities can be achieved relative to the linear counterpart. Moreover, the symmetry of the disk geometry affords simplicity of channel and

superconducting magnet design. When operting in the radial flow mode, the disk is a pure Hall-effect device. However, it has been demonstrated theoretically that a combination of radial flow with inlet swirl opposing the azimuthal Lorentz force can substantially increase the disk's turbine and electrical efficiency. At Hall coefficients lower than five, the disk generator with swirl is expected to have better performance than the radial (Hall) configuration. The performance and efficiency of a small disk generator with 45° inlet swirl are presented. Electrical and thermodynamic properties measured in the generator plasma are analyzed including (1) voltage and static pressure distributions in the generator, (2) stagnation pressure and electron density at the generator exit, and (3) swirl vane and electrode voltages.

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 53373

53369 (FE—2613-6(Vol.4A)) **MHD-ETF Program final report, January 4, 1977—March 4, 1978. Volume 4A. Appendices A01—A03.** (General Electric Co., Philadelphia, PA (USA). Space Div.). Mar 1978. Contract EF-77-C-01-2613. 330p. P 15/MF A01.

A comparison of cyclone and fluidized bed combustor concepts for open cycle MHD is given. Also detailed design considerations for a two-stage, cyclone combustor for open cycle MHD and a two-stage, fluidized bed combustor for open cycle MHD are presented. The studies were performed to establish a reference design for the Magnetohydrodynamic Engineering Test Facility. (WHK)

53370 (FE—2613-6(Vol.4C)) **MHD-ETF Program final report, January 4, 1977—March 4, 1978. Volume 4C. Appendices A09—A16.** (General Electric Co., Philadelphia, PA (USA). Space Div.). Mar 1978. Contract EF-77-C-01-2613. 230p. P 11/MF A01.

Design requirements and specifications are given for some components of the MHD Experimental Test Facility. The Faraday channel structural/mechanical design; the diagonal channel structural/mechanical design; nozzle design; diffuser performance; diffuser and expansion joint structural/mechanical design; magnet and support systems design and specifications; and the design and specifications for the inverters and electrode control for both the Faraday and diagonal wall generator are presented in detail. (WHK)

53371 (FE—2613-6(Vol.4D)) **MHD-ETF Program final report, January 4, 1977—March 4, 1978. Volume 4D. Appendices A17—A25.** (General Electric Co., Philadelphia, PA (USA). Space Div.). Mar 1978. Contract EF-77-C-01-2613. 312p. P 14/MF A01.

The design and specifications are given for some components of the MHD Experimental Test Facility. The alternate design and reference design are given for the high temperature air heaters. Design and specifications are given for the spoiler/radiant boiler, seed separators, and steam generator sections and heat recovery components. Also plans for implementing the required ETF integrated control subsystem are detailed; the Engineering Data Acquisition Subsystem is described; and instrument and control measurement and cabling lists are included. MHD effects on instrumentation are discussed. (WHK)

DUCT ENGINEERING AND FLUID DYNAMICS

REFER ALSO TO CITATION(S) 53367, 53368, 53370

53372 (CONF-790640—3) **Condensation and deposition of seed in the MHD bottoming plant.** Im, K.H.; Patten, J.; Johnson, T.R.; Tempelmeyer, K. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 8p. P 02/MF A01.

From 18. symposium on engineering aspects of magnetohydrodynamics; Butte, MT, USA (18 Jun 1979).

The computer models of slag vapor nucleation and particle deposition have been extended to predict the growth and deposition of seed particles in the steam and air heater sections of the MHD bottoming plant. The model represents a hot combustion gas stream, which contains vaporized seed and entrained slag particles of a selected initial size distribution, flowing through a bank of cooled tubes. The energy balance includes convective and radiant heat transfer to the cool surfaces. The material balance for the condensible species considers convective mass transport of seed vapor to cool surfaces, and the deposition of particles on cooled surfaces by thermophoresis. The analyses provide the bases for design trade-off studies of steam tube size and spacing, gas velocity, and system configuration to optimize the effectiveness and cost of the steam plant. In the absence of entrained slag particles, sample calculations indicated that, as the gas is cooled in passing through a tube bank, the bulk of the seed vapor condenses in the gas stream to form particles with diameters in the range of 0.02 to 0.2 μm. In the presence of the submicron slag particles formed upstream in the MHD diffuser, the largest fraction of the seed vapor condenses on the existing entrained particles, causing them to grow to a size in the range of approximately one micron. In both cases, these particles are deposited on heat exchange surfaces throughout the heat recovery system and a large fraction is present in the cool combustion gas entering the exhaust gas clean-up system.

53373 (FE—2519-6) **MHD generator component development. Quarterly report, April 1978-June 1978.** (Avco-Everett Research Lab., Inc., Everett, MA (USA)). Sep 1978. Contract EF-77-C-01-2519. 179p. P 09/MF A01.

The program objectives and scope-of-work at Avco Everett Research Laboratory concerning MHD Generator test channels are discussed. Several channel configurations and experiments are discussed in detail, including transonic and subsonic channel behavior, electrode-wall boundary layer modeling, insulator wall boundary layer modeling, and in-channel electrode arcs. Post test material analysis and characterization of anode and cathode electrodes are presented and the electrode and insulator wall configuration is described. Preliminary test results on a twelve electrode consolidation circuit are reported. Coal combustion research and modeling is discussed. The purpose and present status of four reference channels and progress on two CDIF scale channels are summarized.

53374 (MIT-EL—78-005, pp 51-61) **Statistical approach in time series fluctuation analysis of electron temperature and electron density in an MHD generator.** Jongbloed, A.A.; Hellebrekers, W.M. (Eindhoven Univ. of Tech., Netherlands). Mar 1978.

From 8. closed-cycle specialists' meeting; Cambridge, MA, USA (19 May 1977).

From the radiation energy due to electron-Cs^+ recombinations in a cesium-seeded noble-gas MHD generator information is obtained about the behavior of electron temperature and electron density. After sampling the radiation energy signals at two wavelengths during 1 msec in experiments with a shock tunnel facility, two 1000-samples sequences are generated: one is the temperature sequence T/sub e/; the other given the density N/sub e/. In order to investigate the presence of a possible relation between T/sub e/ and N/sub e/, some statistical correlation properties are the topic of observation here.

FUEL CELLS

REFER ALSO TO CITATION(S) 53353

DESIGN AND DEVELOPMENT

REFER ALSO TO CITATION(S) 53377, 53381

PERFORMANCE AND TESTING

53375 (BNL—50951, pp 10-16) **Solid electrolyte fuel cells. Analysis of overpotentials in solid electrolyte fuel cells.** Isaacs, H.S.; Olmer, L.J. Dec 1978.

In Fuel cells: applied research fuel cell materials and electrocatalysis. Annual report, January 1-December 31, 1977.

Alternating and direct current methods were used to investigate overvoltage characteristics of the oxygen reduction reactions on platinum paste electrodes in yttria stabilized zirconia. A three-electrode technique was used. Platinum electrodes of ball type with a single contact with the electrolyte showed the same polarization characteristics as the paste electrodes. The decrease of current with time is due to the sintering of the platinum catalyst particles. Impedance measurements at the electrode-electrolyte interface were analyzed in terms of an analogue of two resistances in series, one of which was paralleled by a capacitor. With the vapor deposited electrolyte, the calculated series resistance was considerably higher than that accounted for by the resistivity of the electrolyte and its thickness. The time constant of the interfacial impedance is independent of potential, unlike that observed for aqueous electrochemical systems. The rate-controlling step involves a concentration gradient of adsorbed oxygen molecules, atoms or ions in the electrode or on the electrolyte. An alternate explanation is that the reaction rate is determined by hole conduction in the electrolyte.

53376 (BNL—51038, pp 13-22) **Solid electrolyte fuel cells. Analysis of overpotentials in solid electrolyte fuel cells.** Isaacs, H.S.; Olmer, L.J. Apr 1979.

In Fuel cell applied research: electrocatalysis and materials. Semi-annual report, January 1-June 30, 1978.

Alternate and direct current techniques were used to analyze and identify individual contributions to overpotentials in solid electrolyte fuel cells. The electrolyte configuration was either of the electrochemically vapor deposited type (EVD), from Westinghouse R and D Center, or slip-cast tubes of yttria stabilized zirconia (YSZ), as obtained from Zirconium Corporation of America. The three contributions to the ac impedance arise from the electrolyte, grain boundaries in the electrolyte and the electrode-electrolyte interface. The ac measurements were made on the platinum electrodes, vapor

deposited on YSZ, as a function of frequency to elucidate the contributions to the total impedance in the potential regions where the oxygen evolution and reduction reactions occur. The effects of aging were also determined. The changes in the impedance with potential show that the interfacial process is the main contributor to the total impedance at negative potentials, while the series resistance is predominant at positive potentials. Aging the electrode increases the interfacial impedance at negative potential but has little effect on the impedance at positive potentials. One possible reason for the relatively high series resistance with the EVD electrolyte is due to the presence of impurities. Attempts were made to determine impurities using methods such as proton induced x-ray analysis, scanning transmission electron microscopy, and x-ray fluorescence with th slip-cast electrolyte. Results are presented and discussed.

MATERIALS, COMPONENTS, AND AUXILIARIES

53377 (BNL—50951) **Fuel cells: applied research fuel cell materials and electrocatalysis. Annual report, January 1-December 31, 1977.** Srinivasan, S.; Isaacs, H.S.; O'Grady, W.E.; Russell, P.G.; Olender, H.; Davidson, C.R.; Olmer, L.J.; Tseung, A.C.C. (Brookhaven National Lab., Upton, NY (USA)). Dec 1978. Contract EY-76-C-02-0016. 40p. P 03/MF A01.

Separate abstracts were prepared for the four sections included. (WHK)

53378 (BNL—50951, pp 1-5) **Electrocatalysis of fuel cell reactions. Inhibition of sintering of fuel cell catalyst particles: electrochemical methods for surface regeneration.** Olender, H.; Isaacs, H.S.; Tseung, A.C.C.; O'Grady, W.E. Dec 1978.

In Fuel cells: applied research fuel cell materials and electrocatalysis. Annual report, January 1-December 31, 1977.

One of the main reasons for the loss in performance with time in fuel cells is due to the sintering of the catalyst particles. The fast cycling method was used for the periodic regeneration of unsupported Teflon bonded platinum black electrodes. Experiments were conducted in 85% phosphoric acid at 150°C. The time variation of current density for oxygen reduction at a potential of 0.6 volts vs the reversible hydrogen electrode was recorded. The surface areas were measured in situ at desired time intervals by the hydrogen adsorption technique. After 1000 hours, there was a decrease in current density and electrochemically active surface areas by about 40%. By cycling the potential of the electrode between 0 and 1.3 volts at the optimum sweep rate of 100 volts/sec, the initial activity and surface area could be restored. The rate of decay of current density with the rejuvenated electrode followed the same pattern as the fresh electrode. On the basis of the rsults obtained, the mechanism of regeneration by the fast cycling method appears to be by a charge injection on the agglomerated particles, which causes an electrostatic repulsion and hence a dispersion of the particles.

53379 (BNL—50951, pp 6-9) **Electrocatalysis of fuel cell reactions. Oxides as oxygen electrodes.** Davidson, C.R. Dec 1978.

In Fuel cells: applied research fuel cell materials and electrocatalysis. Annual report, January 1-December 31, 1977.

Two classes of mixed oxides were investigated as oxygen electrodes in potassium hydroxide. The first class consisted of some rare earth perovskites (Ba_2MnReO_6, Ba_2CoReO_6, Ba_2MnWO_6, Ba_2CoWO_6, and Sr_2NiWO_6). These compounds were synthesized by solid state reactions at elevated temperatures. Teflon bonded electrodes were prepared and examined for oxygen reduction in a floating mode. The polarization characteristics indicated evidence for the reduction of the oxides in the potential region for oxygen reduction. The second class of oxides investigated were nikel-iron spinels, Ni/sub 1+x/Fe/sub 2-x/O_6, with -0.8 ≦ x ≦ 0.4. X-ray powder patterns of the powders prepared by the freeze-drying method and subsequent heating to allow crystallization revealed the spinel structure. Magnetic and oxygen reduction electrode kinetic measurements on the nickel-iron spinels indicated a correlation between electrocatalytic activity and saturation magnetization--the lowest electrocatalytic activity is exhibited by the stoichiometric spinel which has the highest saturation magnetization.

53380 (BNL—50951, pp 17-27) **Solid electrolyte fuel cells. Selection and evaluation of interconnector materials.** Russell, P.G.; Isaacs, H.S.; Tseung, A.C.C. Dec 1978.

In Fuel cells: applied research fuel cell materials and electrocatalysis. Annual report, January 1-December 31, 1977.

Efforts were made to investigate new types of materials to be used in the fabrication of interconnectors for solid electrolyte fuel cells. One of the important requirements of interconnection materials is that their thermal expansion coefficients must be nearly the same as that of the electrolyte-yttria stabilized zirconia so as to prevent stresses. In addition, such materials must have other requisite properties--high electronic conductivity; chemical and physical compatibility with other cell components; and resistance to degradation in oxidizing (air) or reducing (fuel) environments. The approach used was to examine plastic materials, which could also prevent build-up of stresses. The materials investigated were doped iron and titanium oxides (Fe_2O_3) in soda lime and silica glasses. The resistivities, densities, and the stabilities of these materials in contact with fuel, air, and zirconia were determined. The other variable included sintering temperature. The present work demonstrates that the doped titania-glass composites appear to have the desired properties for fabrication of interconnectors in solid electrolyte fuel cells. Controlled addition of Nb_2O_5 to TiO_2 increases the electronic conductivity of the material. The glass matrix was found to make only a small contribution to the measured resistance. Further investigations to determine possible recrystallization due to annealing or mass transport in electric fields, compatibility with anode and cathode materials, and methods of fabrication of composite in a pore-free thin layer are essential before using these materials as interconnectors in solid electrolyte fuel cells.

53381 (BNL—51038) **Fuel cell applied research: electrocatalysis and materials. Semi-annual report, January 1-June 30, 1978.** Srinivasan, S.; Isaacs, H.S.; O'Grady, W.E.; Olender, H.; Olmer, L.J. (Brookhaven National Lab., Upton, NY (USA)). Apr 1979. Contract EY-76-C-02-0016. 50p. P 03/MF A01.

Separate abstracts were prepared for the two sections included. Also included is a synopsis of the workshop on the electrocatalysis of fuel cell reactions held at Brookhaven National Laboratory on May 15 and 16, 1978. (WHK)

53382 (BNL—51038, pp 1-11) **Electrocatalysis of fuel cell reactions. In situ surface area determinations: phosphoric acid concentration and temperature effects.** O'Grady, W.E.; Olender, H.; Isaacs, H.S. Apr 1979.

In Fuel cell applied research: electrocatalysis and materials. Semi-annual report, January 1-June 30, 1978.

Investigations were made on the use of the fast cycling method for the periodic regeneration of the activity of unsupported Teflon bonded electrodes. In these studies, the time variation of current density for oxygen reduction at 0.6 V versus the reversible hydrogen electrode was recorded, and the surface areas were measured in situ by the hydrogen adsorption technique. Similar measurements were made after activation by fast potential cycling. These studies revealed the necessity for investigating the effects of temperature and phosphoric acid electrolyte composition on the electrochemically active surface area, as determined by the in situ hydrogen adsorption technique. Increasing the temperature from 25 to 150°C does not alter the extent of hydrogen adsorption on smooth platinum wire and unsupported Teflon bonded platinum black electrodes from 85% phosphoric acid. However, one of the peaks in the cyclic voltammogram disappears at higher temperatures. This behavior is similar to that found by addition of chloride ions and is probably due to blocking of a particular adsorption site. The oxide formation region also exhibits significant changes. Increasing the phosphoric acid concentration from 85 to 105% at 150°C causes a 5 to 10% decrease in hydrogen adsorption on unsupported platinum black electrodes. The extent of oxide formation, which commences at higher anodic potentials, is also decreased.

53383 (FE—2468-37) **Plan for the development of fuel processors for fuel cell systems. Final report on Task 008.** Wilk, A.S. (Engineering Societies Commission on Energy, Inc., Washington, DC (USA)). Nov 1978. Contract EF-77-C-01-2468. 106p. P 06/MF A01.

A plan for the development of fuel processors for dispersed applications of fuel cell systems is documented. Dispersed refers to applications of small size which cannot economically tolerate the complexities of coal handling. Consequently, the fuel processors considered in the plan are limited to those which produce a hydrogen-rich fuel cell feed from liquid and gaseous hydrocarbon fuels, which are petroleum-derived or coal-derived. State-of-the-art for fuel processors is taken to be steam reforming as developed by United Technologies Corporation (UTC). The UTC reformer extends the theme of conventional reforming by utilizing a conventional steam reforming catalyst in a compact unit which demonstrates good load-following characteristics. Load-following is an important requirement of most dispersed applications of fuel cell systems. Like conventional steam reforming, the UTC reformer is limited to relatively lighter and cleaner hydrocarbon fuels (190°C maximum end point naphtha contaning 0.5 vppm sulfur maximum). The direction of the plan is to support the demonstration of fuel cell systems by uncovering needs and developing technologies that will facilitate the commercial application of the state-of-the-art reformer. Due to the future uncertainties of fuels availability, the plan is also directed towards broadening the range of fuels that may be converted to a hydrogen-rich fuel cell feed to include heavier petroleum-derived and coal-derived hydrocarbon liquids.

ELECTROCHEMISTRY, MASS TRANSFER, AND THERMODYNAMICS

REFER ALSO TO CITATION(S) 53375, 53376

ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 52745, 53271, 53290, 53291, 53293, 53294

BUILDINGS

REFER ALSO TO CITATION(S) 52892, 53150, 53325, 53327, 53328, 53329, 53330, 53331, 53333, 53334, 53335, 53336, 53337, 53338, 53339, 53340, 53341, 53342, 53343, 53344, 53345, 53346

53384 (AED-Conf—78-270-003) **One year's thermal insulation ordinance from the point of view of a planning office.** Opladen, K. 1978. 4p. (In German). (CONF-7809122—1). U 02/MF A01.

From 2. building physics congress on the occasion of the ISO/glass technical fair; Duesseldorf, F.R. Germany (28 Sep 1978).

Critical comments are given on the act on Energy Saving in Buildings' and the Ordinance on Energy-Saving Thermal Insulation from the point of view of an engineering office.

53385 (CONF-790672—4) **Implications of seasonal peak demand forecasts for electric heating desirability.** Santini, D.J. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 8p. P 02/MF A01.

From International symposium on modeling, planning, and decision in energy systems; Montreux, Switzerland (19 Jun 1979).

The peak demands for heating and cooling as a function of building type and climate are estimated. Electric utilities' peak summer and winter electrical demands arising from use of typical electric appliances (air conditioners, resistance heating, and heat pumps) are estimated for present and predicted saturations of these appliances in many major US metropolitan areas. Most US electric utilities presently have excess capacity during winter months and are improving their load factor as sales of electric heating appliances significantly exceed historical levels. It is shown that this opportunity for load factor improvement will be transitory in many cases. Metropolitan areas fall into three categories: those (1) in which excess winter capacity is likely to be available regardless of electric heating saturation; (2) with current excess winter capacity that will become winter peaking with present heat appliance installation rates; and (3) presently winter peaking. The conclusion of the research is that, in case (3) US rates of heating appliance installation are slightly excessive. In case (2) the rates are now desirable, but if continued would be excessive by the turn of the century. For case (1) it is desirable to continue the rates indefinitely.

53386 **Relationship between energy considerations and noise control in new residential developments.** Hemingway, J.R. (SNC/GECO Canada Inc., Toronto, Ontario). pp 5.2.2.1-5.2.2.6 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

The Province of Ontario has taken a leading position with regard to the control of both indoor and outdoor noise levels on new residential developments. Some of the noise control methods in use offer definite possibilities for both energy conservation and solar energy collection. Other methods have opposite effects and increase energy consumption. This interdisciplinary paper examines both areas, pointing out where energy conservation can be very easily accomplished simultaneously with noise control, and also examining methods of handling both concerns even when they have opposing influences.

RESIDENTIAL BUILDINGS

REFER ALSO TO CITATION(S) 52903

53387 (BKL—1978-2) **Method for the calculation of the energy balance in buildings.** Kaellblad, K.; Adamson, B. (Tekniska Hoegskolan, Lund (Sweden). Inst. foer Byggnadskonstruktionslaera). Mar 1978. 46p. (In Swedish). U 03/MF A01.

A method is described for estimating the heating requirements for a building without the use of complicated computer calculations. In these calculations the additional heat from domestic electricity, persons, hot water and solar radiation is taken into account.

53388 (EUR—6261EN) **FREDOCAN: a computer program for the analysis of energy policies in the household sector. Description of a test case for the North of Italy.** Conti, F.; Maineri, M. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). 1979. 45p. U 03/MF A01.

The computer program FREDOCAN was developed at JRC-Ispra to assess the impact of energy-conservation policies in the household sector as a result of thermal-insulation measures. The program performs evaluations of both energy and financial investments and savings resulting from given policies. These are typically characterized by: housebuilding rates, insulation regulations, possibilities of higher insulation standards in new houses, additional insulation of existing houses, and options concerning domestic heating plants. The program consists of two parts: the first part performs the computation of the overall useful heat requirements corresponding to a policy of domestic insulation; heat savings and investments with respect to policy with lower insulation levels are determined. The second part uses the information provided by the first part to calculate the total heating plant capacity and the fuel consumption necessary to provide the required space heat. Higher building-insulation levels lead to smaller investments in the heating plants. Additional savings and different costs of the useful heat can be obtained according to the various heat-source options. A test case with an insulation policy for Northern Italy is described in this report to show the possibilities of FREDOCAN.

53389 (HCP/M1693—03) **Alternative metering practices: implications for conservation in multifamily residences.** (Booz, Allen and Hamilton, Inc., Bethesda, MD (USA)). Jun 1979. Contract EC-77-C-03-1693. 227p. P 11/MF A01.

The effects of single unit metering, submetering and master metering of electricity and natural gas consumption in multi-unit dwellings on energy conservation, the effect of the Public Utility Regulatory Act of 1978 on metering practices, policy and institutional issues associated with metering, and the economic and technical optimization of utility metering methods are examined in detail. It is concluded that any comprehensive metering policy should allow individual, submetering, and master metering because each has a role to play in promoting more efficient energy use in multifamily buildings. (LCL)

53390 (LBL—9174) **Effects of energy efficient ventilation rates on indoor air quality at a California high school.** Berk, J.V.; Hollowell, C.D.; Lin, C.; Turiel, I. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1979. Contract W-7405-ENG-48. 44p. P 03/MF A01.

The indoor air quality in an air conditioned California high school has been measured over a range of ventilation rates ranging from 13.3 ft^3 of outside air per minute for each classroom occupant to approximately 1.5 cfm per occupant. The purpose of this pilot study is to determine the effect of reduced ventilation on indoor air quality and energy use. Parameters measured include outside air supply rate, occupants' subjective perception of indoor air quality, microbial burden and the concentrations of carbon dioxide, carbon monoxide, nitrogen oxides, sulfur dioxide, and ozone in two classrooms, a hall, and outdoors. Results show that carbon dioxide was the only parameter to show a substantial increase in indoor concentration when ventilation rates were reduced; however, classroom levels of carbon dioxide still remained far below levels considered to be a health hazard. This study indicates that at Carondelet High School, moderate energy savings are possible without significant deterioration of indoor air quality, and that substantial energy savings would be possible in a more severe climatic region.

53391 (ORO—5552-4(Vol.2)) **Improving the efficiency, safety, and utility of wood burning units. Quarterly report No. WB-4.** Dyer, D.F.; Maxwell, T.T.; Maples, G. (Auburn Univ., AL (USA). Dept. of Mechanical Engineering). 15 Sep 1978. Contract EC-77-S-05-5552. 158p. P 08/MF A01.

The purpose of the work described in this volume is to study the gasification of wood under conditions similar to those found in a stove or fireplace. This study is then used to gain knowledge regarding the validity of the technique used to measure the combustion efficiency of a stove or fireplace during the testing now in progress at Auburn University as part of the program. Five samples each of pine, sweet gum and poplar were heated in the absence of air at temperatures ranging from 600°F to 1000°F. The cross-sectional temperature, weight loss and composition of exhaust gas were monitored throughout each test. It was found that, in general, concentrations of CO_2 and CO decrease during a test, whereas concentrations of CH_4 and H_2 increased significantly, approximately midway through each run. An exothermic reaction within the core of each sample was noted which corresponded with increased production of CH_4 and H_2. Increasing the ambient temperature of the furnace simply served to accelerate the decomposition of each sample and to increase the amounts of CH_4 and H_2 produced. The heating value of the exhaust gas from poplar at 1000°F has been calculated and plotted versus time, and the combustion efficiency using this gas as fuel has been calculated using actual stove test data for the products side of the combustion equation. The results of these calculations are also plotted versus time.

53392 **Energy conservation design guide for architects.** Acheson, A.L.K. (McGill Univ., Montreal, Quebec). pp 8.2.2.1-8.2.2.11 of

Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

The Design Guide approach has been chosen as the most successful method of providing the right information at the right time; it consists of a series of charts based on the twelve part Plan of Work published by the Royal Institute of British Architects. It identifies the stages at which energy savings are possible and provides the relevant design information or indicates a convenient source for locating it.

53393 Solutions to energy conservation in northern climates. Tymura, E.J. (Tymura Solardesigns, Thunder Bay, Ontario). pp 8.2.4.1-8.2.4.14 of Renewable alternatives. Volume 1. Winnipeg, Manitoba; Solar Energy Society of Canada Inc. (1978).

From 4. annual conference of the Solar Energy Society of Canada, Inc.; London, Canada (20 Aug 1978).

Energy conservation approached through careful consideration of climactic conditions has been applied in the design of the Tymura residence located in northwestern Ontario, demonstrating a combination of passive solar heating, active solar water heating systems and partially underground construction. Performance data and construction details (slide presentation) of the McIntosh residence located at Quetico Centre, Atikokan, Ontario, will be updated and analyzed to evaluate the Active-Plenum Solar System in a working state. Also discussed will be the design elements for Castlegreen Housing Co-op Solar Design, a five unit apartment complex, one of National Research Council's Multi-Family Residential Design Grants.

OFFICE BUILDINGS

53394 (DOE/CS/5255—2) **State options in lighting: efficiency standards for existing public buildings.** Meeker, F. (Environmental Law Inst., Washington, DC (USA)). Jul 1979. Contract EM-78-C-01-5255. 53p. P 04/MF A01.

This report discusses requirements and options for state lighting-efficiency standards for existing public buildings under the Energy Policy and Conservation Act. EPCA, as implemented under present regulations, is found to allow great flexibility to the states in what they adopt, so long as they do adopt some standard. A wide variety of substantive standards is described, and it is recommended that states adopt a standard based on a maximum-lighting power budget with cost-effectiveness criteria. Several options for adoption and enforcement of standards are discussed. It is recommended that states adopt a requirement that owners of all public buildings submit reports of lighting energy audits and estimates of energy savings from modifications to comply with substantive standards. It is further recommended that while filing of reports should be mandatory, substantive compliance, at least initially, need not be; if it turns out that voluntary compliance is not great enought to achieve a state's desired energy savings, compliance could then be made mandatory. It is recommended that exemptions from the standards be limited to small buildings and that variances under a mandatory standard be available only when an applicant can show insufficient capital to make required modifications, even though they would soon pay for themselves in reduced operating costs. It is suggested that a lighting standard of the kind recommended could substantially reduce wasted energy in lighting, be simple enough to be easily understood and applied, be technically and economically reasonable, and allow for needed exemptions without loopholes.

SCHOOL, MUNICIPAL AND OTHER PUBLIC BUILDINGS

REFER ALSO TO CITATION(S) 53394

COMMERCIAL AND INDUSTRIAL BUILDINGS

53395 (IDO—1655-1(Vol.3)) **Energy integrated industrial park concept development study. Volume III. Appendices. Final report.** (Honeywell, Inc., Minneapolis, MN (USA). Energy Resources Center). Nov 1978. Contract EC-77-C-07-1655. 257p. P 12/MF A01.

The Energy Integrated Industrial Park Concept Development Study was initiated to provide information to industry about cost-effective methods of reducing energy consumption. A number of industries co-locate within an industrial park for the purpose of making better use of the thermodynamic availability of fossil fuel, increasing waste energy recovery, sharing common water and waste water treatment facilities, and sharing industrial by-products. Volume III contains 8 appendices. Appendix A describes the detail of the 2-digit and 3-digit SIC analyses of representative industries chosen while representative industry descriptors are presented in Appendix B. Additional appendices are: Fuel Price Data; Life-Cycle Cost Model; Industrial Energy Conservation and Goals; Industrial Interviews; Energy Recovery, Distribution, and Storage Subsystems; and Integration Configurations, Equipment Descriptions, Cost Data. (MCW)

TRANSPORTATION

53396 (CONF-7905105—3) **Transportation technology energy options.** Bernard, M.J. III. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 11p. P 02/MF A01.

From Conference on using land to save energy; Chicago, IL, USA (18 May 1979).

New transportation technologies and their potential contribution to the solution of the energy problem are discussed. DOE transportation technologies briefly discussed are: Stirling and gas-turbine engines; constant-speed accessory-drive system; heavy-duty diesel-truck bottoming cycle; continuously variable transmission; turbocompound diesel engine; gas-turbine bus; new hydrocarbons (broad-cut petroleum fuels); alcohol fuels; synthetic fuels; advanced fuels (hydrogen); electric and hybrid vehicles; marine-diesel bottoming cycle; coal/oil-slurry marine steam turbines; pipeline bottoming cycle; and medium-speed diesel alternative fuels.

AIR AND AEROSPACE

53397 (AD-A—062609) **An analysis of fuel conserving operational procedures and design modifications for bomber/transport aircraft. volume ii. Final report, 7 June 1976-7 July 1978.** Aggarwal, R.K. (Dynamics Research Corp., Wilmington, MA (USA). Systems Div.). Jul 1978. Contract F33615-76-C-3104. 500p. Y A21/MF A01.

Various proposed improvements in the design and operational procedures for bomber/transport aircraft are evaluated. The evaluation is performed in terms of the estimated savings in fuel consumption and in Direct Operating Cost (DOC). As an aid in the evaluation of design modifications, graphs of fuel and DOC savings as a function of the design parameters are developed. These graphs are based on actual mission trajectory data rather than some typical trajectory profile. The actual mission data is presented in terms of histograms which provide statistical information concerning altitude, air speed, take-off weight, landing weight, and mission time. Separate analyses are performed on the following aircraft: the B-52G, the B-52H, the KC-135, the C-141, the C-130, and the C-5A. (Author)

LAND AND ROADWAY

53398 (DOE/EIA/8435—1) **Light duty vehicle fuel consumption model, 1975-1986.** (Energy and Environmental Analysis, Inc., Arlington, VA (USA)). 28 Apr 1978. Contract EM-76-C-01-8435. 28p. P 03/MF A01.

The report summarizes the Light Duty Vehicle Fuel Consumption Model developed for the Office of Conservation and Advanced Energy Systems Policy in the Department of Energy. The purpose of the model is to estimate annual passenger auto (PA) and non-passenger auto (NPA) fuel consumption through 1986. The model is intended to: (1) provide information on future estimated petroleum demand for the majority of the US transportation sector; and (2) generate a better understanding of the trends in fuel consumption in light of fuel economy standards issued by the Department of Transportation (DOT) under the Energy Policy and Conservation Act of 1975 (EPCA). The model also is designed to provide disaggregated data for PA's and NPA's in order to anayze their relative importance in estimating total fuel consumption and to calculate the proportion of diesel, leaded, and unleaded fuels in total fleet consumption.

53399 (ORAU—157) **Handbook for state and local energy conservation programs in transportation.** Treat, N.; Williamson, B.; McDonald, E. (Oak Ridge Associated Universities, Inc., TN (USA)). May 1979. Contract EY-76-C-05-0033. 71p. P 04/MF A01.

The handbook focuses on three effective road-vehicle fuel-conservation programs that State and local governments can do now with minimal expenditure of time and money. These programs are: ridesharing, driver energy awareness, and the Voluntary Truck and Bus Fuel Economy program. These programs are described and, whenever possible, draw on the experience and published material of a number of State energy offices, the Transportation Systems Utilization office at the US Department of Energy, and the Department of Transportation Heavy Duty Vehicle Research office. Wherever possible, summaries of effective State and private sector initiatives in the three programs listed are included as examples of what has been accomplished already.

INDUSTRY AND AGRICULTURE

REFER ALSO TO CITATION(S) 53270, 53395

53400 (IDO—1655-1(Vol.1)) **Energy integrated industrial park concept development study. Volume I. Executive Summary. Final report.** (Honeywell, Inc., Minneapolis, MN (USA). Energy Re-

sources Center). Nov 1978. Contract EC-77-C-07-1655. 16p. P 02/MF A01.

The Energy Integrated Industrial Park Concept Development Study was initiated to provide information to industry about cost-effective methods of reducing energy consumption. In the concept, a number of industries co-locate within an industrial park for the purpose of making better use of the thermodynamic availability of fossil fuel, increasing waste energy recovery, sharing common water and waste water treatment facilities, and sharing industrial by-products. The industrial sector was divided into six classes of industry. Four discrete integration concepts were defined in the initial stages of the study. These are: central power generation (all of the process steam and/or electrical power requirements of the industries in a park are supplied by a central fossil-fuel-fired facility); central intensive (heat is recovered in the form of steam from high temperature process exhaust gases of one industry, upgraded as necessary, and distributed for process use to one or more different user industries); centralized systems (heat is recovered from several waste streams of each of the participating industries, transported to a central point, upgraded, converted to steam and electricity, and distributed back to the user industries); and cascade (high quality waste heat is recovered from one industry and used by another; and the lower quality waste heat from the latter industry is recovered and used to supply some or all of another industry's energy requirements, etc.). A hybrid combination consisting of combining two or more of the four primary concepts was evaluated. Results are given for each of these concepts after each was evaluated for typical: installation and operating costs, reductions of energy consumption credited to the member industries, and economic benefits accruing to the member industries. (MCW)

53401 (IDO—1655-1(Vol.2)) **Energy integrated industrial park concept development study. Volume II. Detailed results. Final report.** (Honeywell, Inc., Minneapolis, MN (USA). Energy Resources Center). Nov 1978. Contract EC-77-C-07-1655. 215p. P 10/MF A01.

A feasibility study is made of an energy integrated industrial park concept to provide DOE and industry the direction to pursue the concept. The concept consists of industries co-located within an industrial park and interconnected to minimize raw energy inputs. Under this concept, the use of fossil fuels would be reduced by using waste energy streams of industries as fuel inputs to other industries and providing on-site power generation capability and using the waste energy stream more efficiently. The method of selecting industries at the 4-digit SIC level, representative of the industrial sector from surveying all 3-digit SIC industries and classifying them with respect to energy use and waste stream characteristics, is described. Those selected were analyzed in detail to describe energy input requirements and waste stream characteristics for each process within the industry. The study is concerned with more than technical and economic feasibility of each concept; it is also concerned with the nontechnical issues that will strongly affect the perceived feasibility of the various integration concepts. Other issues are: management, operation, and financing options; impact of incorporating nonenergy utilities and services; and constraints on, risks in, and incentives for development of EIIP concepts. (MCW)

53402 **Dairy: energy connection.** Washington, DC; National Independent Dairies Association (1979). 131p. (DOE/TIC—10221). The Publisher, 1730 K St., N.W., Suite 1302, Washington, DC $10.00.

Application of the recommendations made in this handbook can result in a 20 to 30% reduction in costs for energy in the dairy industry. The recommendations include some that cost nothing to implement, most which involve only small investments for profitable returns, and a few that involve a large investment, but with reasonable payback periods. Energy-use patterns at various dairies were analyzed and actual energy audits were performed to determine energy cost reductions. From these audits, energy cost reduction recommendations were developed based on: short payback periods, wide range of applicability, and ease of implementation. Implementation costs, payback period, and first- and ten-year savings are discussed in detail for 27 energy conservation measures. (MCW)

ENERGY SOURCES

REFER ALSO TO CITATION(S) 52443, 52447, 52469, 53522, 53703

53403 (COO—4929-1) **Use of precalciners to remove alkali from raw material in the cement industry. Quarterly technical progress report, August-October 1978.** Miller, F.M. (Portland Cement Association, Skokie, IL (USA)). Nov 1978. Contract EM-78-C-02-4929. 18p. P 02/MF A01.

A literature survey assisted in defining the role of $CaCl_2$ and limitations on its applicability to alkali reduction experimentation. Additional insight into the mechanism and parameters of heat exchange in the precalciner-type kiln systems has been gained from the literature search, which culminated in the preparation of the bibliography covering thermal treatment of raw materials. Experiments investigating the efficiency of alkali volatization from pure argillaceous minerals are underway. Initial results have been encouraging, as significant fractions of total alkali were volatilized even under the static conditions employed. Clay minerals were, rather surprisingly, more resistant to alkali removal than feldspars when $CaCl_2$ was used. This may indicate that their structure collapsed upon removal of some alkali, and that $CaCO_3$ should be added to the clay burns.

53404 (ORNL/TM—6551) **Potential shift from oil and gas to coal in industrial boilers.** Samuels, G. (Oak Ridge National Lab., TN (USA)). Aug 1979. Contract W-7405-ENG-26. 95p. P 05/MF A01.

This study presents the cost of generating industrial process steam from oil-, gas-, and coal-fired boilers; the cost of fuel for various regions of the United States; and the distribution of industrial boiler installations by size, region, and type of fuel consumed. These data were combined to estimate the potential shift from oil or gas to coal in these installations. With late 1977 fuel prices, it is estimated that about one-half of the current oil and gas used in large ($> 100 \times 10^6$ Btu/h) industrial boilers can be economically shifted to coal. An increase in the price of oil by 50% would increase this potential shift to about 90%.

EQUIPMENT AND PROCESSES

REFER ALSO TO CITATION(S) 52444, 53142, 53408

53405 (ANL/OEPM—79-3) **Survey of electrochemical metal winning processes. Final report.** Vaaler, L.E. (Battelle Columbus Labs., OH (USA)). Mar 1979. Contract W-31-109-ENG-38. 260p. P 12/MF A01.

The subject program was undertaken to find electrometallurgical technology that could be developed into energy saving commercial metal winning processes. Metals whose current production processes consume significant energy (excepting copper and aluminum) are magnesium, zinc, lead, chromium, manganese, sodium, and titanium. The technology of these metals, with the exception of titanium, was reviewed. Growth of titanium demand has been too small to justify the installation of an electrolyte process that has been developed. This fact and the uncertainty of estimates of future demand dissuaded us from reviewing titanium technology. Opportunities for developing energy saving processes were found for magnesium, zinc, lead, and sodium. Costs for R and D and demonstration plants have been estimated. It appeared that electrolytic methods for chromium and manganese cannot compete energywise or economically with the pyrometallurgical methods of producing the ferroalloys, which are satisfactory for most uses of chromium and manganese.

53406 (CONF-7906112—2) **Energy accounting in canning tomatoe products.** Singh, R.P.; Carroad, P.A.; Chhinnan, M.S.; Rose, W.W.; Jacob, N.L. (California Univ., Davis (USA); National Food Processors Association, Berkeley, CA (USA)). 1979. Contract EY-76-C-07-1570. 20p. P 02/MF A01.

From IFT meeting; St Louis, MO, USA (10 Jun 1979).

An energy-accounting method was used to determine energy use in various unit operations in canning tomato juice, whole-peeled tomatoes, and tomato paste. Data on steam and electric consumption were obtained from a canning plant with the use of steam flow meters and electric transducers. Unit operations associated with the following equipment were investigated: crushers, hot-break heaters, pulpers, finishers, lye-bath peelers, evaporators, and retorts. Data were analyzed to determine amount of energy used per unit of raw product. Energy-intensive operations were identified for future modifications to reduce energy consumption.

WASTE HEAT RECOVERY AND UTILIZATION

REFER ALSO TO CITATION(S) 52442, 52445, 52446, 53132, 53547

53407 (COO—4196-3, pp VI.1-VI.28) **High pressure steam generation from heat recovery boilers.** McMillin, R.G. (Carnegie-Mellon Univ., Pittsburgh, PA). Sep 1978.

In Energy conservation in coal conversion. Final report, September 15, 1977—September 1, 1978. Selected case studies and conservation methodologies.

This report develops a methodology for calculating and evaluating the increased work potential possible from high pressure steam generation in waste heat boilers. This methodology is applied to the Ralph M. Parsons commercial concept of the Oil/Gas Complex. Implementation of the proposed scheme would result in an export power increase of 7.7 MW which is a 4% increase of the 210 MW generated by the Oil/Gas Complex at a cost of $2110/KW.

53408 (DOE/EDP—0039) **Environmental Development Plan: industrial programs.** (Department of Energy, Washington, DC (USA)). Jul 1979. 94p. P 05/MF A01.

The Environmental Development Plan system is designed to provide a common basis for planning, managing, and reviewing the

environmental aspects of the various energy-technology programs under DOE jurisdiction. An EDP is expected to identify and evaluate the environmental concerns; define general requirements for environmental, health, and safety research and impact assessments; provide a coordinated timing schedule for required environmental research and development, technology program activities, and decision points; and indicate approximate time for documents required in the National Environmental Policy Act process and Environmental Readiness Documents, where appropriate. This EDP addresses the Industrial Energy Conservation Program in the following activities: high-temperature processes, low-temperature and manufacturing processes, waste-energy utilization and cogeneration, alternative-materials utilization, and agriculture and food processes.

INDUSTRIAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 52511

53409 (ANL/OEPM—79-2) **Survey of metallurgical recycling processes. Final report.** Pemsler, J.P. (EIC Corp., Newton, MA (USA)). Mar 1979. Contract W-31-109-ENG-38. 201p. P 10/MF A01.

In the year 2000, the US will consume about 3.2 x 10^{15} Btu to produce the seven major nonferrous metals covered in this study: Al, Cu, Zn, Pb, Ni, Mg, and Ti. Of this amount, 82% will be used in the production of Al. It is projected that 0.6 x 10^{15} Btu will be saved by the recycle of secondary metals. Major opportunities for increasing the extent of recycle and thereby increasing the energy savings are discussed. An inherent feature in the energistics of recycle is that physical processes such as magnetic separation, density separations, melting, and in some instances vaporization are far less energy intensive than are chemical processes associated with dissolution and electrowinning. It is in the domain of scrap of complex composition and physical form, difficult to handle by existing technology, that opportunities exist for new chemical recycle technology. Recycle of scrap metal of adequate grade is currently achieved through pyrometallurgical processes which, in many cases, are not very energy intensive as compared with hydrometallurgical processes. Preliminary flowsheets are presented for the recovery of value metals from batteries considered for use in vehicular propulsion and load leveling applications. The battery types examined are lead/acid, nickel/zinc, nickel/iron, zinc/chlorine, lithium-aluminum/iron sulfide, and sodium/sulfur. A flow sheet has been outlined for an integrated hydrometallurgical process to treat low-grade copper scrap. A fully integrated hydrometallurgical process is outlined, and costs and energy consumption are derived, for recovering zinc metal from electric furnace flue dusts. Costs and energy are high and the process does not appear to warrant development at this time. Improvement in the recycle of magnesium is associated primarily with improved recycle in the Al industry where Mg is an important alloy additive. Ni and Ti recycle are associated with improved collection and sorting of stainless steel and specialty alloys.

53410 (CONF-790499—2) **Metal removal from coal ashes and wastes.** Canon, R.M.; Kelmers, A.D.; McDowell, W.J.; Seeley, F.G.; Watson, J.S. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 16p. P 02/MF A01.

From American Society of Civil Engineers Power Research Council/Electric Power Research Institute workshop; San Diego, CA, USA (23 Apr 1979).

Laboratory-scale tests and preliminary engineering economic analyses have been performed to evaluate several processes for the recovery of aluminum and other metals from fly ash. Preliminary tests have also been made on two coal conversion ashes. The processes examined include: direct acid leach, lime-sinter, lime-soda sinter, and two new sinter-leach processes (calsinter and salt-soda sinter). The Calsinter process involves sintering with limestone and gypsum or flue gas desulfurization sludge at 1000 to 1200°C, followed by sulfuric acid leaching. Each of the new sinter-leach processes recovers more than 95% of the aluminum along with substantial percentages of the other metals present. The recovered metals can be converted to a number of potentially saleable products.

53411 **Food, fertilizer, and agricultural residues.** Loehr, R.C. (ed.). Ann Arbor, MI; Ann Arbor Science Publishers, Inc. (1977). 735p. (CONF-7704106—).

From Cornell Agricultural Waste Management conference; Syracuse, NY, USA (27 Apr 1977).

Alternatives to waste disposal in the management of agricultural wastes are considered in the papers presented. The topics discussed are: application of waste waters to land, interactions of sludge and soil and crop production, nutrient management, methane generation, energy utilization and production, and animal waste management. Abstracts were prepared for selective papers for input into the EDB data base. (JSR)

MUNICIPALITIES AND COMMUNITY SYSTEMS

REFER ALSO TO CITATION(S) 53289

PUBLIC UTILITIES

REFER ALSO TO CITATION(S) 52528, 53288

53412 (ORNL/TM—6830/P2) **District heating/cogeneration application studies for the Minneapolis-St Paul area. Executive summary; overall feasibility and economic viability for a district heating/new cogeneration system in Minneapolis-St. Paul.** Margen, P.; Larsson, K.; Cronholm, L.A.; Marklund, J.E. (Oak Ridge National Lab., TN (USA)). Aug 1979. Contract W-7405-ENG-26. 41p. P 03/MF A01.

A study was undertaken to determine the feasibility of introducing a large-scale, hot-water, district-heating system for the Minneapolis-St. Paul area. The analysis was based on modern European hot-water district-heating concepts in which cogeneration power plants supply the base-load thermal energy. Heat would be supplied from converted turbines of existing coal-fired power plants in Minneapolis and St. Paul. Toward the end of the 20-year development period, one or two new cogeneration units would be required. Thus, the district-heating system could use low-grade heat from either coal-fired or nuclear cogeneration power stations to replace the space-heating fuels currently used - natural gas and distillate oil. The following conclusions can be drawn: the concept is technically feasible, it has great value for fuel conservation, and with appropriate financing the system is economically viable.

MUNICIPAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 53132, 53276, 53277, 53278, 53279, 53280, 53281, 53358, 53359

53413 (ANL/CNSV-TM—5) **Proceedings: energy from urban wastes workshop, Washington, DC, September 11-12, 1978.** Cohen, A.S.; Brooks, C. (eds.). (Argonne National Lab., IL (USA)). Jun 1979. Contract W-31-109-ENG-38. 173p. P 08/MF A01.

This workshop, for members of public interest groups, was sponsored by DOE's Urban Waste Technology Branch to provide information on the use of urban waste as an energy resource. A separate abstract was prepared for each of seven presentations plus the Summary of discussions. Two acts are included as appendices: (1) Public Law 95-238: Department of Energy Act of 1978 - Civilian Applications; and (2) Public Law 94-580: Resource Conservation and Recovery Act of 1976.

EDUCATION AND PUBLIC RELATIONS

REFER ALSO TO CITATION(S) 53292

ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

INTERNAL COMBUSTION ENGINES

DIESEL

REFER ALSO TO CITATION(S) 53419, 53420, 53421

53414 (TID—29410) **Technical status report No. 4, May 1—July 31, 1978.** (Thermo Electron Engineering Corp., Waltham, MA (USA)). Aug 1978. Contract EF-77-C-01-2647. 40p. P 03/MF A01.

The feasibility of operating a typical two-stroke, large bare diesel engine on coal-based fuels for generation of power to meet electric utility and industrial power demands was studied. From this assessment, it is clear that with exception of the COED, or perhaps the SRC2 type fuels, none of the fuels under consideration have a reasonable degree of likelihood to be successfully injected into the diesel cylinder by conventional systems. Although there are technical concepts available for the design and eventual realization of injectors for all fuels considered, a substantial amount of further development has to be provided before these injectors could become a practical reality.

TURBINE

53415 (COO—2749-31) **Baseline Gas Turbine Development Program. Twenty-second quarterly progress report.** Pampreen, R.C.;

Wagner, C.E. (comps. and eds.). (Chrysler Corp., Detroit, MI (USA)). 30 Apr 1978. Contract EY-76-C-02-2749. 80p. P 05/MF A01.

Progress is reported for a program whose goals are to demonstrate an experimental upgraded gas turbine-powered automobile which meets the 1978 Federal Emissions Standards, has significantly improved fuel economy, and is competitive in performance, reliability, and potential manufacturing cost with the conventional piston engine-powered, compact-size American automobile. Activity during this twenty-second program quarter has continued to emphasize development towards correcting a power deficiency in the Upgraded Engine. Efforts are also being directed towards reducing fuel usage through improved heat recovery and towards improving the mechanical reliability and control of the engine.

ELECTRIC-POWERED SYSTEMS

REFER ALSO TO CITATION(S) 53257

53416 (JPL-PUB—79-51) **Review of composite material applications in the automotive industry for the electric and hybrid vehicle. Annual report, November 1978.** Bauer, J.L. (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Jul 1979. Contract EM-78-I-01-4209. 90p. P 05/MF A01.

A comprehensive review is made of the state-of-the art in regard to the use of composite materials for reducing the structural mass of automobiles. Reduction of mass will provide, in addition to other engineering improvements, increased performance/range advantages that are particularly needed in the electric and hybrid vehicle field. Problems to be overcome include the attainment of mass production techniques and the prevention of environmental hazards.

HYBRID SYSTEMS

REFER ALSO TO CITATION(S) 53416

VEHICLE DESIGN FACTORS

BODY AND CHASSIS

53417 (DOE/JPL/152170—T1) **Aerodynamic characteristics of sixteen electric, hybrid, and subcompact vehicles. Complete data.** Kurtz, D.W. (Jet Propulsion Lab., Pasadena, CA (USA)). Jun 1979. Contract NAS-7-100-152170. 95p. (JPL-PUB—79-59). P 05/MF A01.

The report presents an elementary electric and hybrid vehicle aerodynamic data base and describes how it was developed. Sixteen electric, hybrid, and subcompact production vehicles were tested in the Lockheed-Georgia low-speed wind tunnel. Zero-yaw drag coefficients ranged from a high of 0.58 for a boxey delivery van and an open roadster to a low of about 0.34 for a current four-passenger prototype automobile which was designed with aerodynamics as an integrated parameter. Vehicles were tested at yaw angles up to 40 degrees and a wind weighting analysis is presented which yields a vehicle's effective drag coefficient as a function of wind velocity and driving cycle. Other parameters investigated included the effects of windows open and closed, radiators open and sealed, and pop-up headlights. Complete six-component force and moment data are presented in both tabular and graphical formats. Only limited commentary is offered since, by its very nature, a data base should consist of unrefined reference material. A justification for pursuing efficient aerodynamic design of EHVs is presented which demonstrates the partitioning of the road energy requirement and the dependence of range upon the aerodynamic drag component over an electric vehicle driving cycle. Establishing this data base is one required element of a larger task, the purpose of which is to develop an aerodynamic design guide for use by the EHV industry.

WEIGHT

REFER ALSO TO CITATION(S) 53416

53418 (PB—290394) **Ford fairmont weight reduction baseline data. Final report, April-September 1978.** Siegel, H.M.; Andon, J. (South Coast Technology, Inc., Santa Barbara, CA (USA)). Sep 1978. Contract DOT-HS-7-01790. 106p. Y A06/MF A01.

A weight study was conducted of the Ford Fairmont 4-door sedan with 4-cylinder engine and 4-speed manual transmission. The vehicle teardown was limited to the detail necessary to be useful to project near term weight reduction for automotive fuel economy studies. A complete parts list, which includes component description, quantity per car, total weight per car, material description, method of fabrication, and gauge thickness and photographs of the major components, are presented.

EMISSION CONTROL

53419 (NTIS/PS—79/0037) **Diesel exhaust emissions. Volume 2. 1977-January 1979 (citations from the NTIS data base). Report for 1977-January 1979.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Feb 1979. 113p. Y N01/MF N01.

Aspects of exhaust gases from stationary and vehicular diesel engines are presented in these citations of Federally-funded research. This includes their pollution potential, composition, control, and formation processes in combustion reactions. The effects of achieving better fuel consumption on the types of exhaust gases formed are covered. Research concerned with the health effects of these exhaust gases is included. (This updated bibliography contains 107 abstracts, 39 of which are new entries to the previous edition.)

53420 (NTIS/PS—79/0038) **Diesel exhaust emission control motor vehicles (citations from the Engineering Index data base). Report for 1970-January 1979.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Feb 1979. 266p. Y N01/MF N01.

Worldwide citations were selected that discuss the control of exhaust gases from diesel motor vehicle engines. Most of the studies are concerned with emission control through engine design; however, some studies also cover the use of fuel additives for pollution control. (This updated bibliography contains 261 abstracts, 55 of which are new entries to the previous edition.)

53421 (NTIS/PS—79/0039) **Diesel exhaust emissions (citations from the American Petroleum Institute data base). Report for 1974-December 1978.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Feb 1979. 160p. Y N01/MF N01.

This bibliography contains citations on different aspects concerning exhaust emissions from diesel motor vehicles. Included is engine design, techniques of measuring the gases, different fuel additives, and odor control. (Contains 155 abstracts)

ALTERNATIVE FUELS

REFER ALSO TO CITATION(S) 53414

MATERIALS

REFER ALSO TO CITATION(S) 52421

53422 (UCRL—50028-79-2) **H-Division quarterly report, April-June 1979.** (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Jul 1979. Contract W-7405-ENG-48. 34p. P 03/MF A01.

This report defines the objectives of groups in H Division of the LLL Physics Department and describes the status of projects under way: Theoretical EOS Group - new screening coefficients for XSNB, condensed at high compression, development of a multicomponent hypernetted-chain code, EOS for TEULER; Experimental Physics Group - precise Hugoniot measurements for Al, flash x-ray diffraction; Fluid Physics Group - research on fundamental mechanisms of turbulent gas/solid erosion analysis of nonsteady boundary-layer flows; dust dispersion in turbulent, erosive flow; hypervelocity rail-guided projectile launch, erosion, and drag predictions, bulk viscosity through nonequilibrium molecular dynamics; Code Development/Applied Physics Group - target penetration: target surface response to penetration, comparison of calculation and experiment of a convergent jet. Detailed individual reports on completed work may be expected. 28 figures, 1 table. (RWR)

METALS AND ALLOYS

REFER ALSO TO CITATION(S) 52422

53423 (ORNL—5579) **Metals and Ceramics Division annual progress report, October 1, 1978-June 30, 1979.** Peterson, S. (ed.). (Oak Ridge National Lab., TN (USA)). Sep 1979. Contract W-7405-ENG-26. 72p. P 04/MF A01.

Research is reported concerning: (1) engineering materials including materials compatibility, mechanical properties, nondestructive testing, pressure vessel technology, and welding and brazing; (2)

fuels and processes consisting of ceramic technology, fuel cycle technology, fuels evaluation, fuels fabrication and metals processing; and (3) materials science which includes, ceramic studies, physical metallurgy and properties, radiation effects and microstructural analysis, metastable and superconducting materials, structure and properties of surfaces, theoretical research, and x-ray research and applications. Highlights of the work of the metallographic group and the current status of the High-Temperature Materials Laboratory (HTML) and the Materials and Structures Technology Management Center (MSTMC) are presented. (FS)

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 53432, 53439

53424 (EUR—5897, pp 295-309) **Comparison between experimental and theoretical data for Am and Cm build-up in the Trino Vercellese PWR.** Peroni, P. (Ente Nazionale per l'Energia Elettrica, Rome (Italy)); Guzzi, G. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). 1978.

From 1. technical meeting on the nuclear transmutation of acinides; Ispra, Italy (16 Apr 1977).

Calculations of Pu, Cm and Am buildup has been performed by ENEL by means of the RIBOT computer code. This code calculates for a fuel cell, the evolution in time of the neutron spectrum, of the concentration and of the cross sections of each heavy isotopes. The code provides the utilization of U and Th isotopes. For this purpose, it has been modified in order to allow the calculation of isotopic evolution of Am and Cm without considering their influence on the neutron spectrum and on the reactivity.

53425 (ORNL/TM—6669) **Room-temperature elastic-plastic tests of plate-weldment specimens.** Delph, T.J.; Battiste, R.L.; Richardson, M. (Oak Ridge National Lab., TN (USA)). Aug 1979. Contract W-7405-ENG-26. 71p. AT.

Room-temperature strain measurements were performed on three welded plates under elastic-plastic loading conditions. The plate specimens were fabricated from type 304 stainless steel base metal and were welded transversely with type 308 stainless-steel-controlled residual element weld metal. Two of the specimens contained welds in the annealed condition, while the third contained a weld in the as-deposited condition. Residual stress measurements were made on similar specimens using the hole-drilling technique. Concurrent elastic-plastic finite-element analyses of all three tests were conducted. The analytically predicted strains showed fair agreement with experimentally measured values in the case of the two annealed weld specimens. However, the agreement in the case of the as-deposited weld specimen was considerably poorer. The measured residual stress fields were included in the finite-element analyses of two of the tests, but the results showed poorer agreement with experiment than did the analyses in which residual stress effects were ignored.

53426 (ORNL/TM—6890) **Weldability of modified 9 Cr-1 Mo steels.** Edmonds, D.P.; Sturgill, P.L. (Oak Ridge National Lab., TN (USA)). Aug 1979. Contract W-7405-ENG-26. 21p. AT.

Modified 9 Cr-1 Mo steels with improved mechanical properties for use in advanced breeder reactor systems were evaluated. Additions of niobium, vanadium, and a reduction of silicon have resulted in good high-temperature creep strength and ductility. However, high concentrations of some minor elements have contributed to hot cracking during welding of ferritic steels. Therefore, Tigamajig (modified Varestraint) tests were preformed to investigate heat-affected-zone (HAZ) hot cracking in these experimental heats. Ten small (36 kg each) electroslag remelted (ESR) heats, one large (2300-kg) ESR heat, and one heat of 2 1/4 Cr-1 Mo steel (for a reference material) were invetigated. Highly restrained welds were made with the most crack-sensitive experimental heat (from Tigamajig results) to determine the relevance of the Tigamajig tests. Under normal welding conditions HAZ hot cracking should not be a problem with any of the 11 experimental heats. However, care should be taken with high concentrations of minor elements since they tend to increase sensitivity to cracking. There were no obvious correlations between crack sensitivity and either chromium equivalent, δ-ferrite content, or the amount of very large grains (elephant grains) in the structures.

53427 **Dependence of necking upon loading history.** Hopper, R.W. (Lawrence Livermore Lab., CA). *Scr. Metall.;* **13**: No. 8, 689-694(Aug 1979).

Dependence and the shape of tensile specimens upon deformation was studied. It was shown that the flow stress is a function of the strain and strain rate. The shape evolution is independent of deformation history if S(e,e') = f(e)e/sup m/. (FS)

53428 **In-situ HVEM recovery annealing of Al single crystals.** Scattergood, R.O.; Hasegawa, T. (Argonne National Lab., IL). *Scr. Metall.:* **13**: No. 8, 723-727(Aug 1979).

In-situ annealing experiments were made in a high voltage electron microscope using thin foils prepared from prestrained bulk Al single crystals to characterize the recovery events. Recovery events involve dislocation interaction and migration, which underlie the structural changes accompanying recovery. A comparison of these results with other results reveal the influence of foil free surfaces. (FS)

53429 **Effects of heat treatment on surface segregation in Inconel 600.** Chaung, H.E.; Szklarska-Smialowska, Z.; Staehle, R.W. (Ohio State Univ., Columbus). *Scr. Metall.;* **13**: No. 8, 753-756(Aug 1979).

Inconel 600 is an important structural material and demonstrates high corrosion resistance at high temperature. Properties of Inconel 600 are effected by heat treatment. The surface composition was studied as a function of annealing temperature. Experiments also assessed the difference in surface segregation between water quenched and furnace cooled alloys annealed at 1100°C.

53430 **Recovery and recrystallization in rolled tantalum single crystals.** Vandermeer, R.A. (Oak Ridge National Lab., TN); Snyder, W.B. Jr. *Metall. Trans., A;* **10**: No. 8, 1031-1044(Aug 1979).

The recovery and recrystallization behavior of rolled tantalum single crystals having initial orientations of (001) [110], (112) [110] and (111) [110] has been studied. Each crystal developed a simple, single component texture upon rolling. The texture became more diffuse and the local lattice curvature more intense as the rolling plane deviated from (001) towards (111). The (001) [11°] and (112) [110] crystals formed a uniform dislocation array and polygonization occurred on annealing. No recrystallization of the (001) [110] crystal took place at temperatures up to 1673 K. A few randomly-oriented recrystallized grains were nucleated in the (112) [110] crystal but these may have been artificially nucleated. Only the (111) [110] crystal reoriented during rolling; it also formed a cellular dislocation microstructure. This orientation was the only one to recrystallize easily, primarily because of the large lattice curvature. The recrystallized grains could be related to the deformation texture by a rotation of 23 to 24 deg about a common <111> direction that was parallel to the normal direction of the sheet. The nature of the misorientation spread after rolling may have dictated this relation as a compromise to the one usually found in bcc materials, viz. 25 to 30 deg rotation about a common <110> axis. Also, wide dislocation cell size distributions were noted in the (111) [110] crystal. The cell size distributions were log normal in nature. Subgrain growth was very much more rapid in this crystal. There was a large discrepancy between the observed subgrain growth and that predicted theoretically by the coalescence model.

53431 (RFP-Trans—273) **Evaluation of forgeability of steels by notch compression method.** Morozumi, F.; Hirasaka, M. Translated from *Zairyo;* **45**: No. 3, 97-102(1970). 15p. P 02/MF A01.

It is assumed that the occurrence of forging defects is accounted for by examing the amount of critical compression and by determining the values of this factor, and so by judging whether the material used was of sound quality and whether the working conditions were right. To justify this reasoning, the notched specimens prepared from carbon, low alloy and alloy steels, were compressed by impact energy, and the relationship between the behavior of forging defects produced at the notch bottom and the value of compression amount was investigated. As the result, it has been ascertained that the critical impact compression amount has a close relation with individual metallurgical factors, such as material and conditions, depending on the external factors such as the working temperature and the working speed. Furthermore, this notch compression method has proved to be an effective means for understanding the tendency of flaw generation in the forging.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 52985, 53430, 53438, 53450, 53502, 53508

53432 (IS-T—857) **Primary dendrite spacing of directionally solidified lead rich Pb—Sn binary alloys.** Klaren, C.M. (Ames Lab., IA (USA)). May 1979. Contract W-7405-ENG-82. 69p. P 04/MF A01.

Thesis.

The primary dendrite spacing (d) of lead rich Pb—Sn alloys resulting from steady state directional solidification was measured as a function of temperature gradient (G), alloy composition (C), and growth velocity (V). The relationship dαG/sup -1/3/ was observed with three different alloy compositions and thermal gradients ranging from 11 to 358°C/cm. The effect of increasing solute content in the alloys was inconclusive, although dendrite spacing generally increased. Growth velocities were varied from 1 to 409 μm/sec in the gradient range from 300 to 400°C/cm. At growth velocities less than 45 μm/sec the dendrite spacings displayed no apparent dependence on the growth rates. This was attributed to the effects of convection and of the concept of a limiting maximum cell spacing as V approaches 0. At growth rates in excess of 45 μm/sec, a dαV/sup

-1/2/ relationship was exhibited. Experimental data were analyzed in terms of several theoretical treatments of dendrite growth. The results indicated that perhaps a more detailed analysis of the problem is necessary in order to encompass the range of growth conditions encountered in this study.

53433 (IS-T—867) **Study of ZrCl by self-consistent band calculation.** Marchiando, J.F. (Ames Lab., IA (USA)). Jul 1979. Contract W-7405-ENG-82. 67p. P 04/MF A01.

Thesis.

A nonrelativistic self-consistent electronic band structure calculation has been performed on zirconium monochloride using the KKR method. The exchange potential was approximated by the Xα method. The compound contains homoatomic layers in the sequence Cl—Zr—Zr—Cl and has the characteristics of a graphite-like two-dimensional metal. A substantial charge transfer is found toward the metallic layers and away from the loosely bonded halogen layer. There is also significant admixture of Zr-d character within the filled Cl-3p bands. The total density of states is in good agreement with the valence band photoemission results.

53434 (SAND—79-1032C) **Study of the replacement collision probability in the case of Co inplanted in Al at 4.2°K.** Odeurs, J.; Pattyn, H.; Verbiest, E.; Coussement, R.; Reintsema, S.R.; Brice, D.K. (Sandia Labs., Albuquerque, NM (USA); Leuven Univ. (Belgium). Inst. voor Kern- en Stralingsfysika). 1979. Contract EY-76-C-04-0789. 19p. (CONF-790843—1). Dep. NTIS, MF A01.

From 8. international conference on atomic collisions in solids; Hamilton, Canada (13 Aug 1979).

Portions of document are illegible.

Earlier Moessbauer effect experiments on ^{57}Co diffused in Al show two different positions for the Co-atoms after irradiation of the sample with fast neutrons: substitutional Co and interstitial Co. In order to study the landing dynamics of Co in Al we have implanted ^{57}Co in Al at 4.2°K, at which temperature the Al-interstitials are still immobile. The total implanted dose was 10^{14} at/cm^2, the implantation energy 85 keV. The Moessbauer spectrum shows one line corresponds to substantial Co-atoms, the other one comes from interstitial Co-atoms (in the <100> Co—Al mixed dumbbell position). The population of the substitutional site, found to be 0.46 +- 0.02, can give information on the interaction potentials between Co—Al and Al—Al when the results are interpreted on the basis of a replacement collision model modified by taking into account a spontaneous trapping volume for the lattice atom recoil, around substitutional Co.

53435 **Effect of solute on the obstacle profiles for dislocation intersection and solution strengthening in Ni alloys.** Mulford, R.A.; Kocks, U.F. (Argonne National Lab., IL). *Scr. Metall.;* 13: No. 8, 729-732(Aug 1979).

The addition of solute to Ni has a strong influence on the dislocation-dislocation interaction processes. This effect is strongest at intermediate temperatures and is explained by a dynamic strain aging mechanism of the dislocation-arrest type. This mechanism operates in alloys which do not exhibit jerky flow and it may be possible on this basis to explain the plateau stress found in many fcc alloys.

53436 **Mass spectrometric determination of the dissociation energy of TcC(g).** Rinehart, G.H.; Behrens, R.G. (Univ. of California, Los Alamos, NM). *J. Phys. Chem.;* 83: No. 15, 2052-2053(26 Jul 1979).

The TcC(g) molecule is observed above a liquid technetium carbide phase of unknown composition by using Knudsen effusion mass spectrometry. Intensity data for Tc(g) between 2229 and 2560°K and for TcC(g) between 2393 and 2395°K give a third-law bond energy of $D^\circ_0 = (134 +- 7)$ kcal mol^{-1} for TcC(g). A value of $D^\circ_0 = (140 +- 2)$ kcal mol^{-1} is obtained by the second-law method. 2 figures.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 52634, 52823, 53425, 53435

53437 (CONF-790802—41) **Fatigue crack propagation in 2 1/4 Cr-1 Mo steel.** Corwin, W.R.; Booker, M.K.; Booker, B.L.P.; Brinkman, C.R. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 8p. P 02/MF A01.

From International conference on structural mechanics in reactor technology; Berlin, F.R. Germany (13 Aug 1979).

The fatigue crack propagation of 2 1/4 Cr-1 Mo steel was examined in air over a wide range of experimental conditions. The fatigue crack growth rate was found to: generally increase monotonically with increasing temperature from 172° to 866°K, except in the range where dynamic strain aging occurs, near 644°K; increase with decreasing frequency at room temperatures above 783°K - this frequency dependence was not observed below 783°K; and increase with increases in mean stress. The results were evaluated, and a simple empirical model was developed to yield estimates of average and upper limit crack growth rates as a function of temperature, frequency, and effective stress intensity. However, the model is not applicable in the low region where threshold effects become important since insufficient data were available in that range.

53438 (GA-A—15194) **Aging behavior of alloy 800H and associated mechanical property changes.** Lai, G.Y.; Kimball, O.F. (General Atomic Co., San Diego, CA (USA)). Nov 1978. Contract EY-76-C-03-0167-050. 28p. P 03/MF A01.

Aging behavior of five different heats of Alloy 800H was investigated in the temperature range 538° to 816°C (1000 to 1500°F) for times up to 8,000 h. Significant age-hardening was observed at low temperatures [i.e., 538°, 593° and 649°C (1000°, 1100° and 1200°F) in most heats. One of the heats, however, exhibited less hardening. Microstructural changes occurring during aging were evaluated by optical metallography, transmission electron microscopy, and x-ray diffraction. Effects of thermal aging on both tensile properties and impact toughness properties were evaluated. The results show that the alloy exhibits good residual impact toughness and tensile ductility after aging up to 8,000 h.

53439 (IS-M—195) **Effect of nitrogen concentration on temperature dependent mechanical properties of vanadium.** Carlson, O.N.; Rehbein, D.K.; Bogacik, K.E. (Ames Lab., IA (USA); Babcock and Wilcox Co., Lynchburg, VA (USA)). 1979. Contract W-7405-ENG-82. 13p. (CONF-790801—1). P 02/MF A01.

From 5. international conference on the strength of metals and alloys; Aachen, F.R. Germany (Aug 1979).

The critical resolved shear stress and strain rate sensitivity of vanadium were determined for vanadium—nitrogen alloys over the temperature range of 77K to 400K for concentrations of 1 to 500 wt ppM nitrogen. The concentration dependence of the hardening rate agrees quite well with either the Fleischer or Labusch strengthening model but the combined temperature and concentration dependence follows more closely the form predicted by Ono and Sommer. The strain rate sensitivity exhibits a peak at 140K which decreases with increasing nitrogen content but above 250K there is a reversal in this effect.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 52984, 53004, 53777, 53868

53440 (ANL—77-78) **General model for turbulent momentum and heat transport in liquid metals.** Sha, W.T.; Launder, B.E. (Argonne National Lab., IL (USA)). Mar 1979. Contract W-31-109-ENG-38. 66p. AT.

A general single-point closure scheme for calculating the local levels of turbulent fluxes of momentum and heat in liquid-metal flows is developed. Transport effects are accounted for by way of the three scalar quantities: turbulence kinetic energy, k; turbulence-energy dissipation rate, ϵ; and scalar energy (or half the mean temperature variance), g. Their values at any point in the flow are obtained from the solution of conservation equations of transport type for each of the three quantities. The turbulent momentum fluxes (Reynolds stresses) and heat-transport rates are then obtained from algebraic formulas containing the above scalar quantities and the mean velocity and temperature fields. Various applications of the model are discussed; the proposed model has a wide range of applicability.

53441 (BNL—25949) **Softening of Young's modulus of polycrystalline Nb_3Sn.** Welch, D.O.; Bussiere, J.F.; Suenaga, M. (Brookhaven National Lab., Upton, NY (USA)). Jun 1979. Contract EY-76-C-02-0016. 5p. (CONF-7906103—2). P 02/MF A01.

From International conference on martensite transformations; Boston, MA, USA (24 Jun 1979).

Ultrasonic measurements show that the shear modulus $(C_{11}-C_{12})/2$ softens dramatically as single crystals of Nb_3Sn approach the martensitic transition near 50K. It is expected that Young's modulus of polycrystals will olso soften, but previous ultrasonic measurements, which suffer from severe damping, fail to show the expected effect. We have measured Young's modulus of polycrystalline Nb_3Sn between 4.2K and 300K by static beam deflection methods, and observe marked softening. A value of 14.3 +- .5 x 10^{11} dyne cm^{-2} was obtained at 300K by the deflection of thin Nb_3Sn-Nb-Nb_3Sn composite strips by external stress. The variation of the modulus with T was obtained from the change in the radius of curvature of internally stressed Nb_3Sn-Nb composite strips. (This method is made possible by the near perfect match between the thermal expansion coefficients of Nb and Nb_3Sn.) The modulus is found to be proportional to lnT between 50K and 300K and is temperature independent below the superconducting T/sub c/, resulting in a decrease by a factor of ~ 2 between 300K and 18K. The observed softening is somewhat less than that predicted by a polycrystalline average of the experimental single crystal elastic constants, but is much larger than that observed with ultrasonic measurements.

53442 (CONF-790641—7) **Effect of group III A and IV A element substitutions (M) on the hydrogen dissociation pressures of LaNi/sub 5-x/M/sub x/ hydrides.** Mendelsohn, M.H.; Gruen, D.M. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 7p. P 02/MF A01.

From Rare earth research conference; Fargo, ND, USA (25 Jun 1979).

Ternary modifications of the hydrogen absorbing alloy $LaNi_5$ have been found to have a large effect on the hydrogen dissociation pressure of the corresponding hydride. A series of alloys $LaNi_{4.6}M_{0.4}$ (M = Al, Ga, In, Sn) were studied to establish the effect of various group III A and IV A element substitutions on the dissociation pressures of their corresponding hydrides. Results were extended to include the alloys $LaNi_{4.6}Si_{0.4}$, $LaNi_{4.6}Ge_{0.4}$ and $LaNi_{4.4}B_{0.6}$. Further dissociation pressure measurements were made on the alloy $LaNi_{4.6}Ga_{0.4}$ as well as two additional indium alloys. The data obtained for the three indium alloys appear to follow a linear correlation of lnP or ΔG with the amount of substituted element as has been previously observed for Al.

53443 (CONF-790653—13) **Fermi surface measurements in A-15 compounds.** Arko, A.J.; Crabtree, G.W.; Fisk, Z. (Argonne National Lab., IL (USA); California Univ., San Diego, La Jolla (USA). Inst. of Pure and Applied Physical Sciences). 1979. Contract W-31-109-ENG-38. 15p. P 02/MF A01.

From Superconductivity in d- and f-band metals; San Diego, CA, USA (21 Jun 1979).

New dHvA data in Nb_3Sb are presented and compared with the various band calculations, and progress of Fermi surface measurements in A-15 compounds in general is reviewed. (GHT)

53444 (COO—1198-1265) **Satellite NMR in Cu doped with transition impurities.** Slichter, C.P. (Illinois Univ., Urbana (USA)). 1979. Contract EY-76-C-02-1198. 10p. (CONF-790738—3). P 02/MF A01.

From Joint INTERMAG-MMM conference; New York, NY, USA (17 Jul 1979).

Measurements were made of the conduction electron spin magnetization density, M/sub σ/(R vector) near iron group atoms (Sc through Ni) in Cu. M/sub σ/(R vector) produces an additional effective local field which shifts the NMR frequency of nearby shells of Cu nuclei relative to Cu nuclei far from all impurities. Resonances of nearby shells appear as weak satellites to the strong resonance of distant Cu nuclei (the main line). M/sub σ/(R vector) at a given site is proportional through know constants to the splitting of the satellite from the main line. The shell was identified giving rise to the satellite in many cases by use of single crystals. A good approximation M/sub σ/(R vector) is proportional to the spin susceptibility chi/sub s/ of the impurity. For CuCr we find a large temperature independent chi/sub s/, in contrast to CuMn and CuFe. The results lead to a picture of the electronic structure of Cr, Mn, and Fe along the lines of Schrieffer and Hirst as ions with integral numbers of d-electrons, possessing crystal field and spin-orbit couplings.

53445 (COO—4946-1) **Studies of metal—semiconductor interfaces in catalysis and energy conversion. Annual report, June 15, 1978—June 14, 1979.** Chung, Y.W. (Northwestern Univ., Evanston, IL (USA)). Mar 1979. Contract ER-78-S-02-4946. 20p. P 02/MF A01.

The installation of a multiple-technique surface analytical system capable of Auger, photoemission (UPS and XPS), low-energy electron diffraction, thermal desorption and thin-film evaporation studies was completed. An isolation cell attachment was designed for high-pressure gas-phase (1 to 1000 torr) reaction studies. By depositing nickel onto a clean ordered TiO_2(110) surface held at room temperature, an ordered overlayer was obtained as evidenced by LEED. Both energy loss and uv photoemission studies showed that there is an electron transport from nickel to TiO_2, resulting in an increase of the surface Ti^{3+} concentration and the formation of an accumulation layer on the TiO_2(110) surface. In addition, uv photoemission results suggested that the Ni atoms and the surface Ti^{3+} are well dispersed on the TiO_2 surface. Auger studies on the clean $SrTiO_3$(100)-lxl surface showed that the strontium Auger signal decreases abruptly as the temperature is raised beyond 240°C. This is believed to be a result of the outward displacement of the topmost TiO_2 layer relative to the second SrO layer. Platinum deposition on the $SrTiO_3$(100)-lxl surface results in the removal of surface Ti^{3+} and the formation of a Schottky barrier at the interface. This result is discussed in light of the recent findings in photoelectrolysis. 9 figures.

53446 (IS-T—862) **Magnetic and electronic properties of Nd—La and Ce—La alloys.** Petersen, T.S. (Ames Lab., IA (USA)). May 1979. Contract W-7405-ENG-82. 72p. P 04/MF A01.

Thesis.

The electrical resistivity, thermoelectric power and magnetic susceptibility on Nd single crystals and polycrystalline dhcp Nd—La and Ce—La alloys have been measured at low temperatures. The measurements on the Nd—La alloys show features at the Neel temperatures and also show additional magnetic ordering phenomena. Some of these other features are dependent on the thermal history of the sample. Magnetic field studies are needed to correlate these features with observed neutron diffraction effects. Several magnetic features are seen in the Ce—La alloy system also, although the measurements are plagued with the problem of fcc contamination. In addition, alloys containing Ce show Kondo effects. The logarithmic term in the resistivity is explained well by the theory of Liu et al. which uses a mean field to approximate the 4f-4f interactions in the nondilute alloys. The large peak in the thermopower of Ce—La alloys is explained well by the theory of Bhattacharjee and Coqblin which incorporates Kondo scattering from excited crystal field levels.

53447 (MLM—2634) **$^{238}PuO_2$/titanium compatibility at 800°C and 1000°C.** Schaeffer, D.R.; Teaney, P.E. (Mound Lab., Miamisburg, OH (USA)). 17 Aug 1979. Contract EY-76-C-04-0053. 22p. P 02/MF A01.

The compatibility between $^{238}PuO_2$ and titanium was studied. Test specimens were heated at 800°C for 32 to 720 days and at 1000°C for 30 to 180 days. The results indicate reduction of the $^{238}PuO_2$ by the titanium caused solid solution hardening of the titanium, occasional intergranular attack by plutonium at 800°C, and intergranular and lattice diffusion by plutonium at 1000°C.

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 52565, 52633, 52799, 53138, 53189, 53969

53448 **Corrosion fatigue and stress corrosion cracking of Type 304 stainless steel in boiling NaOH solution.** Boateng, A. (Ohio State Univ., Columbus); Begley, J.A.; Staehle, R.W. *Metall. Trans., A;* **10**: No. 8, 1157-1164(Aug 1979).

Results are reported for corrosion fatigue of Type 304 stainless steel in boiling (140 C) 17.5M NaOH (46 wt pct) solution. Specimens, of the smooth round bar type, were cycled sinusoidally at 1.0 Hz in tension-tension about mean stresses of 248 MPa (36 ksi) and 124 MPa (18 ksi). Both solution annealed and sensitized specimens cracked readily in a transgranular mode. Sensitization did not increase the environmental effect. The caustic solution drastically shortened cyclic life and eliminated the endurance limit observed in air. Cyclic stress was a more important variable than mean stress as the lower mean stress did not significantly improve life. Anodic passivation did not increase cyclic life as it did for constant load SCC. Comparison of the SCC tests results with those of corrosion fatigue indicates that cyclic stresses, even when confined to the elastic region, accelerate failure more than sustained loads in the plastic region; this accelerative effect was most intense under anodic passivation.

53449 **Inhibitive effect of oxyanions on the stress corrosion cracking of Type 304 stainless steel in boiling 20N NaOH solution.** Park, Y.S. (Brookhaven National Lab., Upton, NY); Agrawal, A.K.; Staehle, R.W. *Corrosion;* **35**: No. 8, 333-339(Aug 1979).

The effect of various oxyanions in inhibiting the stress corrosion cracking (SCC) of Type 304 stainless steel in boiling 20N NaOH has been investigated. Times to failure of wire specimens were measured in the absence and in the presence of various oxyanions in the NaOH solution. Out of 16 oxyanions tested, CrO_4^{2-} was found to be the most effective in inhibiting the SCC of Type 304. The CrO_4^{2-} in the caustic solution form a redox couple which shifts the corrosion potential of Type 304 into its passive region where the SCC susceptibility of the alloy is least. The threshold concentration of CrO_4^{2-} in 20N NaOH is 0.005M. No harmful effect of CrO_4^{2-} ions on Type 304 was found in this study in the 5 concentrations from 0.001M to 0.92M investigated.

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 53194, 53195, 53219, 53434, 53970, 53971, 53972, 53973, 53974, 53975, 53976, 53979, 53995

53450 (CONF-790657—4) **Nonequilibrium segregation in concentrated alloys under irradiation.** Lam, N.Q.; Wiedersich, H.; Okamoto, P.R. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 9p. P 02/MF A01.

From Conference on irradiation behavior of metallic materials for fast reactor core components; Corsica, France (5 Jun 1979).

Radiation-induced segregation in concentrated alloys was investigated using a model based on the concept of relative differences in the effective diffusion rates of the alloy components via the vacancy and interstitial mechanisms. Numerical results were obtained for various irradiation conditions and alloy systems and compared with experimental data.

53451 (COO—1198-1274) **Low temperature electron irradiation and annealing of pure cadmium.** Menendez, M.A. (Wright State

Univ., Dayton, OH (USA); Illinois Univ., Urbana (USA)). 1979. Contract EY-76-C-02-1198. 74p. P 04/MF A01.

Thesis.

Cadmium after electron irradiation below 2°K, was studied and the damage production rate in Dc was found to be (4.13 +- .16) x 10^{-26} Ωcm/(e^-/cm^2) for irradiation with 2.5 MeV electrons at 1.5°K. New annealing peaks were observed at 1.825°K and at about 2°K with activation energies of (2.6 +- .1) x 10^{-3} eV and (2.77 +- .34) x 10^{-3} eV, respectively. The peak at about 2°K exhibits dose-dependence, but it is better described by first order kinetics; this peak is believed to correspond to the long-range migration of the self-interstitial, preferentially to impurities where they form clusters. It has been found that subthreshold irradiation results in the annealing of damage already present. This radiation annealing effect may be a contributing factor to the seesaw effect. Another physical process may contribute to the seesaw effect, namely, the trapping of interstitials at impurities and their subsequent detrapping during annealing.

53452 (COO—1367-97) **Effect of point defects on mechanical properties of metals. Technical progress report, January 1, 1978—November 30, 1978.** Meshii, M. (Northwestern Univ., Evanston, IL (USA)). Nov 1978. Contract EY-76-S-02-1367. 23p. P 02/MF A01.

Progress is reported on deformation behavior of niobium single crystals below 77°K, the effect of electron irradiation on the deformation behavior of niobium single crystals, and surface film softening phenomenon in Ni plated iron single crystals. (FS)

53453 (LA—7939-MS) **Irradiation damage in metals produced by 800-MeV protons.** Brown, R.D.; Sommer, W.F.; Green, W.V. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 14p. P 02/MF A01.

Theoretical calculations of damage energies in metals from 800-MeV proton irradiation motivated an experimental transmission electron microscopy study of the damage produced. Damage produced by 800-MeV protons is accompanied by a higher level of helium production than for reactor neutron irradiation. To allow irradiation of samples on a routine basis, a proton irradiation port (PIP) was constructed in beam line A at LAMPF. This port allowed a high damage-rate irradiation of metal foils several mils thick. Irradiations were completed on foils of aluminum, niobium, molybdenum, and vanadium to damage levels between 0.05 dpa and several dpa, the damage occurring at homologous temperatures above 0.5 T/sub m/. Disks were punched from the irradiated foils and thinned for TEM examination. No voids were observed in irradiated aluminum samples. Molybdenum samples showed a low density of cavities which were believed to be gas filled at these high temperatures. Vanadium samples showed a high density of irradiation-produced defects resulting from irradiation-injected impurities. Such defects have been reported previously in ion-irradiated vanadium. The nature of the damage produced is compared to that found at lower temperatures following neutron or ion bombardment.

53454 **Bias factor for irradiation-induced swelling in metals.** Nichols, F.A. (Argonne National Lab., IL). *Scr. Metall.;* **13**: No. 8, 717-721(Aug 1979).

A simple analog to the SIPA (stress-induced preferential absorption) model for radiation creep is presented. New and interesting results are demonstrated for estimating the preferential absorption of interstitials at dislocations leaving a net vacancy current to voids and producing the well-known void swelling effect. (FS)

CERAMICS, CERMETS, AND REFRACTORIES

REFER ALSO TO CITATION(S) 53423

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 52993

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 53457

53455 **Observation of intrinsic and extrinsic secondary grain boundary dislocations in [001] high angle twist boundaries in MgO.** Sun, C.P.; Balluffi, R.W. (Massachusetts Inst. of Technology, Cambridge). *Scr. Metall.;* **13**: No. 8, 757-761(Aug 1979).

An electron microscope was used to investigat grain boundary dislocation (GBD) in MgO using bicrystals of controlled geometry Intrinsic and extrinsic GBD were observed in high angle grain boundaries. It is suggested by this study that GBD may be similar to those found in metals. (FS)

MECHANICAL PROPERTIES

53456 (GA-A—15411) **Elevated temperature controlled-impurity helium aging of ceramics.** Sheehan, J.E. (General Atomic Co., San Diego, CA (USA)). Jul 1979. Contract EY-76-C-03-0167-050. 93p. P 05/MF A01.

Two commercial Al_2O_3 materials, a Si_3N_4, three fused SiO_2 products and graphite foil were exposed to controlled-impurity He at 927°C for up to 5000 h. The He contained H_2, H_2O, CO and CH_4 concentrations representative of steam-cycle HTGR environments. Dense, high purity Al_2O_3 was chemically inert to the He impurities and was compatible in contact with high-purity fused SiO_2 and graphite foil. Minor phases present in the Al_2O_3 materials were stable. The hot-pressed Si_3N_4 containing MgO underwent passive oxidation in the controlled-impurity He. Oxide layers were uneven with thickness up to about 10 μm after 5000 h. The Si_3N_4 was non-reactive in contact with Al_2O_3, fused SiO_2 and graphite foil. No phase instability was detected. Porous, high-purity fused SiO_2 underwent limited reduction in the impure He but was non-reactive in contact with Al_2O_3, Si_3N_4 and graphite foil. Small amounts of devitrification were detected in two of the products after 5000 h. One Al_2O_3, the Si_3N_4 and one fused SiO_2 were strength tested after 5000 h at 927°C in impure He. The strengths of specimens freely exposed to the He and those exposed while in contact with various materials were not significantly different from the strengths of as-received specimens.

53457 (UCRL—83020) **Hugoniot elastic limits and compression parameters for brittle materials.** Gust, W.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Jul 1979. Contract W-7405-ENG-48. 11p. (CONF-790709—12). P 02/MF A01.

From VII international AIRAPT conference; La Creusot, France (30 Jul 1979).

The physical properties of brittle materials are of interest because of the rapidly expanding use of these material in high-pressure and shock wave techology, e.g., geophysics and explosive compaction as well as military applications. These materials are characterized by unusually high sonic velocities, have large dynamic impedances and exhibit large dynamic yield strengths.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 52993, 53004, 53380, 53456

53458 **Electrical resistivities of some spinel ferrites.** Roy, U.; Williams, R.K.; Brundage, W.E.; Weaver, F.J. (Oak Ridge National Lab., TN). *J. Am. Ceram. Soc.;* **60**: No. 1-2, 88-89(Jan 1977).

Electrical resistivity, rho, data obtained on 4 large spinel ferrite single crystals are presented. The crystals were required for a time-of-flight neutron spectrometer; in this application, high rho values are desired to minimize eddy current losses. Primary characterization of the crystals showed that the compositions of all the crystals except $Mn_{0.7}Ga_{0.3}Fe_2O_4$ varied considerably along the growth axis, and rho measurements obtained on an Ni ferrite crystal in the present study showed that rho is quite sensitive to the composition gradient. Microhardness data were obtained to characterize the crystals further, and average values for samples from the 4 crystals varied from 570 to 875 kg/mm^2.

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 53194, 53195

POLYMERS AND PLASTICS

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 53500

PHYSICAL PROPERTIES

53459 (SAND—79-0592C) **Electrical activity in shock-loaded polymers.** Graham, R.A. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 9p. (CONF-790709—14). P 02/MF A01.

From VII international AIRAPT conference; La Creusot, France (30 Jul 1979).

Studies concerning shock-induced conduction and shock-induced polarization phenomena in polymers are summarized and recent results presented.

OTHER MATERIALS

53460 (N—79-14192) **Present status of GaAs.** Gatos, H.C.; Lagowski, J.; Jastrzebski, L. (Massachusetts Inst. of Tech., Cambridge (USA)). Jan 1979. 32p. Y A03/MF A01.

An extensive literature survey on GaAs was carried out for the period December 31, 1970, to December 31, 1977. The increasing interest in GaAs device structures increased steadily during that period. The leading research and development centers and the specific areas of interest were identified. A workshop on GaAs was held in November 1977 to assess the present status of melt-grown GaAs and the existing needs for reliable chemical, structural, and electronic characterization methods. It was concluded that the present available bulk GaAs crystals are of poor quality and that GaAs technology is lagging demonstrated or potentially feasible GaAs devices and systems.

PREPARATION AND MANUFACTURE

REFER ALSO TO CITATION(S) 52773, 52776, 52777, 52780, 52784, 52786, 52790, 52881, 53095

53461 (UCRL-Trans—11486) **Investigation of the BeF_2—ZrF_4 system.** Korenev, Yu.M.; Novosyolova, A.V. Translated from *Dokl. Akad. Nauk SSSR;* **149**: 1337-1339(1963). 6p. P 02/MF A01.

Melts of BeF_2—ZrF_4 were prepared and its form turned out to be like that of quartz. The heating curve of BeF_4 contained effects at 220°, 575°, and 793°C. At 220° the effect corresponds to the $\alpha \rightleftharpoons \beta$ transformation of quartz-like BeF_2. After melting the BeF_2 resolidifies at 580°, turning into a high-temperature modification which melts at 800°.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 53457, 53461, 53764

PROPERTIES

REFER ALSO TO CITATION(S) 52881, 53457, 53461

53462 (COO—1198-1264) **Activation volumes of some superionic conductors with the fluorite structure.** Oberschmidt, J.M.; Lazarus, D. (Illinois Univ., Urbana (USA)). 1979. Contract EY-76-C-02-1198. 11p. (CONF-790538—15). P 02/MF A01.

From Fast ion transport in solids-electrode and electrolytes conference; Lake Geneva, WI, USA (21 May 1979).

Information about defect and conduction mechanisms of ionic conductors can be obtained by studying the pressure and temperature dependence of the electrical conductivity. The existence of several activated regions of conduction was found. The activation volumes, which are extracted from the pressure data, are small and positive throughout the temperature range investigated. This implies that Frenkel defects are dominant up to near the melting points of the materials examined.

53463 (IS-Trans—105) **Determination of the electrical properties and nonstoichiometry of Y_2S_3 at high temperature as a function of the equilibrium sulfur pressure.** Rasneur, J.; Cauchemont, C. Translation of *C. R. Hebd. Seances Acad. Sci., Ser. C;* **286**: 589-592(1978). 6p. P 02/MF A01.

Y_2S_3 is an electronic semiconductor with a chemical composition near the stoichiometry. The variations of conductivity and thermoelectric power as functions of temperature and sulfur pressure indicate a p—n transition. In the p type domain, the defects are constituted by Y vacancies according to the formula Y/sub 2-x/S_3 (with $x < 3 \times 10^{-4}$).

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 52681, 53858

53464 (CALT—822-109) **Effects of neutron irradiation on a superconducting metallic glass.** Kramer, E.A.; Johnson, W.L.; Cline, C. (California Univ., Livermore (USA). Lawrence Livermore Lab.; California Inst. of Tech., Pasadena (USA). W.M. Keck Lab. of Engineering Materials). Jun 1979. Contract EY-76-C-03-0822. 14p. P 02/MF A01.

The effects of fast neutron irradiation on a superconducting metallic glass ($Mo_{.6}Ru_{.4})_{82}B_{18}$ have been studied. Following irradiation to a total fluence of 10^{19} n/cm², T/sub c/ increases from 6.05 K to 6.19 K, and the width of the transition decreases sharply. The density of the material decreases by 1.5%, and the x-ray scattering intensity maxima are broadened. An improvement in the ductility of the samples is observed which together with the other observations suggests the production of defects having atomic scale dimensions and characterized by excess volume.

53465 (COO—2712-7) **TEM studies of graphite irradiated at different neutron energies.** Thrower, P.A.; Gray, W.J. (Battelle Pacific Northwest Labs., Richland, WA (USA); Pennsylvania State Univ., University Park (USA). Dept. of Material Sciences). 1979. Contract EY-76-S-02-2712. 2p. (CONF-790625—7). P 02/MF A01.

From 14. carbon conference; University Park, PA, USA (25 Jun 1979).

Elastic shear modulus C_{44} was studied by irradiating graphite with neutrons of different energy to approximate the increase in C_{44} to simulate graphite irradiation in a fusion reactor. It was found that post irradiation values of C_{44} decreased at an exponential rate to E ∞. TEM observations reveal damage on a very small scale which is barely resolvable. The apparent defect cluster diameter is around 10A.

CHEMISTRY

53466 (LBL—8157) **Minicomputer and computations in chemistry.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1978. Contract W-7405-ENG-48. 57p. (CONF-780779—). P 04/MF A01.

From Minicomputer and computations in chemistry workshop; Berkeley, CA, USA (19 Jul 1978).

The introduction of multiple-precision hardware and longer word lengths has given the minicomputer a much more general potential for chemistry applications. It was the purpose of this workshop to address this potential, particularly as it is related to computations. The workshop brought together persons with minicomputer experience and those who are considering how the minicomputer might enhance their research activities. The workshop sessions were arranged in sequence to address the following questions: (1) Is the general purpose minicomputer an appropriate tool to meet the computational requirements of a chemistry research laboratory? (2) What are the procedures for wisely designing a minicomputer configuration? (3) What special-purpose hardware is available to enhance the speed of a minicomputer? (4) How does one select the appropriate minicomputer and ensure that it can accomplish the tasks for which is was designed? (5) How can one network minicomputers for more efficient and flexible operation? (6) Can one do really large-scale computations on a minicomputer and what modifications are necessary to convert existing programs and algorithms? (7) How can the minicomputer be used to access the maxicomputers at the NRCC? (8) How are computers likely to evolve in the future? (9) What should be the role of the NRCC in relation to minicomputers? This report of the workshop consists mainly of edited transcripts of introductory remarks. These were augmented by relevant bibliographies as an alternative to transcription of the entire workshop. There was no attempt in the workshop to give final answers to the questions that were raised, since the answers are determined in large part by each particular minicomputer environment.

53467 (UCID—15644-79-1) **General chemistry division. Quarterly report, January-April 1979.** Harrar, J. (ed.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Jun 1979. Contract W-7405-ENG-48. 56p. P 04/MF A01.

The following were studied: scavenging behavior of NO_3^- and methyl viologen, fluorescent lifetimes of dibromobimane and thiols, spectral determination of tricresyl borate, salicylaldehyde method for differentiation of primary and secondary amines, ammonia-gas-sensing electrodes, automated manometric CHN analyzer, computer program for calibration of graphite furnace atomic absorption spectrophotometer, contamination of alumina insulator, organic additives for stabilizing colloidal silica in hypersaline geothermal brine, x-ray fluorescence analysis of geological samples, dissolution of geothermal scale, and characterization of enzyme-catalyzed reactions (alkaline phosphatase). (DLC)

53468 **Preprints symposia.** Washington, DC; American Chemical Society (1979). 408p. (CONF-790415—P4).

From 177. national meeting of the American Chemical Society; Honolulu, HI, USA (1 Apr 1979).

These papers were presented at the American Chemistry Society symposia concerning the following topics: (1) olefin polymerization and disproportionation, (2) biomass as a non-fossil fuel source, (3) stack gas cleanup, and (4) advances in petroleum processing.

53469 (ANL-Trans—1166) **Kinetic weight of a process which is one of the links in the system of a complex process. II.** Durdin, Ya.V. Translated from *Zh. Obshch. Khim.;* **16**: 1375-1390(1946). 30p. P 03/MF A01.

In a former paper treating the question of the kinetical weight of: a process which is one of the links in the system of a complex process, the characteristic of the kinetical weight of the process has

been considered, the latter being evaluated from the point of view of the process parameters influence coefficient. This paper deals with the further development of the same question. Having this purpose in mind two more values are introduced, characterizing the kinetic weight of the process: the process equilibrium shift coefficient J^0 and the process velocity decrease coefficient eta^0. All three coefficients are determined in a general case not by the ratio between the velocities of the processes but by the ratio between their inertias, each coefficient being equal to the peculiar expression of the partial inertia of this process. In the general case of a non-linear dependence of the velocities of processes A and B on the regulated parameter and on the final value of the equilibrium shift of both processes the three above mentioned coefficients can have different numerical values. In the peculiar case of the linear dependence of the velocities of the small shift of the equilibrium of one of the processes, all three coefficients have the same value. In this case the kinetic weight of the process may be characterized also by the ratio of the processes velocities under the condition that these velocities correspond to the same value of the shift of equilibrium of both processes. The explanation of the kinetic weight of the process may be applied to a case of systems of purely physical processes such as the process of passage of an electric current through two conductors connected in series or the process of heat conduction in two connected in series bars.

ANALYTICAL AND SEPARATIONS CHEMISTRY

REFER ALSO TO CITATION(S) 52672

53470 (BNL—26128) **Thematic and compositional variation in Palenque-region incensarios.** Rands, R.L.; Bishop, R.L.; Harbottle, G. (Southern Illinois Univ., Carbondale (USA); Brookhaven National Lab., Upton, NY (USA)). 1978. Contract EY-76-C-02-0016. 43p. (CONF-7806150—1). P 03/MF A01.

From Tercera mesa redonda de palenque; Pebble Beach, CA, USA (11 Jun 1978).

Ceramic incensarios were an important component of ritual paraphernalia in the Palenque region. Tubular flanged cylinders - stands or supports for receptacles in which the incense was actually burned - were highly embellished. The primary concern is with these iconographically-rich objects, focusing on variations in thematic presentation and in paste composition. The latter, mineralogical and chemical composition, has significance in that it enables differentiation among centers of production, leading to a better understanding of where clay resources were procured and, inferentially, where the incensarios were manufactured. An attempt is being made to determine if incensarios of Palenque style were manufactured at a single or at multiple sites, if Palenque itself was a production center, and what can be inferred about trading or distributional patterns of these specialized objects.

53471 (ORNL—5518) **Analytical Chemistry Division. Annual progress report for period ending December 31, 1978.** Lyon, W.S. (ed.). (Oak Ridge National Lab., TN (USA)). May 1979. Contract W-7405-ENG-26. 154p. P 03/MF A01.

Research progress is reported on analytical methodology, mass and emission spectrometry, analytical services, bio-organic analysis, and nuclear and radiochemical analysis.

ACTIVATION AND NUCLEAR REACTION PROCEDURES

53472 (PB—289578) **Determination of shell content by activation analysis. Final report, September 1973-August 1978.** Melancon, J.L. (Louisiana Dept. of Transportation and Development, Baton Rouge (USA). Office of Highways). Aug 1978. 56p. Y A04/MF A01.

The objective of this study was to determine if neutron activation analysis technique can be used to determine the shell content of a sand-shell mixture by measuring the amount of calcium. To accomplish this aim, samples of sand and shell, obtained from different sources, were artificially blended in the laboratory in various proportions and subjected to neutron bombardment by use of a californium-252 source. The gamma of specific energy of emission was then counted and analyzed electronically. The nuclear count was then plotted against the known shell content for development of calibration curves for each combination of sand and shell tested. Statistical analysis of the data indicates a strong linear relationship exists between nuclear count (gamma) and percent shell. Test results for 30 sets of sand-shell mixtures indicated a maximum standard error for any single set to be + or - 7.0% of the calibration curve at the 95% confidence level. The mean standard error for the 30 sets tested was + or - 4.2%. Sands from different sources may result in widely different nuclear counts after activation. This effect can be negated by generating a separate calibration curve for each source of sand used.

53473 (N—79-14887) **Utilization of nuclear methods for materials analysis and the determination of concentration gradients.** Darras, R. Translated from *Mem. Sci. Rev. Metall.;* **75**: No. 6, 345-353(Jun 1978). 26p. Y A03/MF A01.

The various types of nuclear chemical analysis methods are discussed. The possibilities of analysis through activation and direct observation of nuclear reactions are described. Such methods make it possible to analyze trace elements and impurities with selectivity, accuracy, and a high degree of sensitivity. Such methods are used in measuring major elements present in materials which are available for analysis only in small quantities. These methods are well suited to superficial analyses and to determination of concentration gradients, provided the nature and energy of the incident particles are chosen judiciously. Typical examples of steels, pure iron, and refractory metals are illustrated.

CHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 52505, 53478, 53517

53474 (GEPP-TIS—455) **Determination of percent calcium carbonate in calcium chromate.** Middleton, H.W. (General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.). 27 Aug 1979. Contract EY-76-C-04-0656. 18p. P 02/MF A01.

The precision, accuracy and reliability of the macro-combustion method is superior to the Knorr alkalimetric method, and it is faster. It also significantly reduces the calcium chromate waste accrual problem. The macro-combustion method has been adopted as the official method for determination of percent calcium carbonate in thermal battery grade anhydrous calcium chromate and percent calcium carbonate in quicklime used in the production of calcium chromate. The apparatus and procedure can be used to measure the percent carbonate in inorganic materials other than calcium chromate. With simple modifications in the basic apparatus and procedure, the percent carbon and hydrogen can be measured in many organic material, including polymers and polymeric formulations. 5 figures, 5 tables.

RADIOMETRIC AND RADIOCHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 52612, 52655, 52721

53475 (GEPP-TIS—444) **X-ray emission spectroscopic determination of iron in a polyurethane encapsulant curing agent.** Carter, J.M.; Kling, E.N. (General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.). 15 Aug 1979. Contract EY-76-C-04-0656. 8p. P 02/MF A01.

Presented is a procedure for determining the iron content in a polyurethane encapsulant curing agent by x-ray emission spectroscopy. Standards were prepared by adding ferric acetyl acetonate to a curing agent of identical composition to that being analyzed, but containing no iron. Results show that x-ray emission spectroscopy is feasible for determination of iron in the 30 to 50 ppM range. This range could probably be extended by the preparation of additional standards. Precision of the method is approximately 1.2 ppM at the 99 percent confidence level.

53476 (LA—1721(Ed.4)(Rev.)) **Collected radiochemical procedures (Radiochemistry Group CNC-11).** Kleinberg, J.; Smith, H.L. (comps.). (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 55p. P 04/MF A01.

This supplement covers separation procedures for elements spanning the range from Bi to Zr, and procedures for quality control in counting radioactive nuclides. (DLC)

53477 (ORP/EERF—79-2) **Eastern Environmental Radiation Facility's participation in interlaboratory comparisons of environmental sample analyses.** Blanchard, R.L.; Strong, A.B.; Lieberman, R.; Porter, C.R. (Environmental Protection Agency, Montgomery, AL (USA). Eastern Environmental Radiation Lab.). Mar 1979. 36p. Eastern Environmental Radiation Facility, P.O. Box 3009, Montgomery, AL.

This report compiles all available results of the EERF's participation in interlaboratory comparison programs. In general the results are satisfactory, although there are some areas of concern. A summary of all analyses for the predominant radionuclides included in this report is presented in tabular form. Also included are the results reported for unspiked samples. Results for the unspiked samples reported as not detectable (ND), zero, or as a value less than the assigned minimum detectable level (MDL) were considered to agree within +- 10%; a value reported as greater than the MDL was considered unsatisfactory. For the 753 specific radionuclide analyses, 75% and 92% were measured within +- 10% and +- 20%, respectively, of the Reference Center values. These data are presented graphically where the cumulative probability is plotted with the observed percent error. The probability that the result of an analysis will be within a selected error of the true concentration can be easily ascertained from the graph. The most important function of intercomparison programs is to identify problem areas. If a problem exists, immediate remedial action should be inititated. Errors can

occur for numerous reasons; improperly following a tested procedure, arithmetical errors in the calculations, permitting contamination to enter the sample during analysis, undetected fluctuations in counting efficiencies, or backgrounds, and using incorrect weights, or absorption factors. (ERB)

53478 (RFP—2840) **Quality engineering and control. Semiannual progress report, May-October 1978.** Carpenter, R.L. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 20 Aug 1979. Contract EY-76-C-04-3533. 26p. P 03/MF A01.

The standard colorimetric procedure for thorium was improved by using lanthanum carrier precipitation of thorium fluoride, conversion to sulfate, and colorimetric measurement with thoron. Four types of anion-exchange resins were evaluated using breakthrough capacity, elution volume, and the neptunium-plutonium ratios in both wash solutions and ion-column eluates as criteria, and 100 to 200 mesh Dowex 1 x 4 resin had the most favorable separation characteristics. Use of commercially available aqueous cleaner followed by water and acetone rinses was found to be superior to other techniques for cleaning uranium samples prior to carbon analysis. The substitution of sodium bisulfate for potassium pyrosulfate in the fusion procedure has lead to a more efficient dissolution process for oxide samples undergoing plutonium assay and the determination of uranium impurities. Sealed-capillary differential thermal analysis experiments were performed to assess the relative reactivities of iron, stainless steel, copper, beryllium, aluminum, and plutonium with trichloroethylene, methyl chloroform, and Freon TF. Results obtained by a method involving reduction of plutonium with titanium (III) chloride followed by titration with standard cerium (IV) sulfate solution are comparable to those obtained by an established amperometric-titration method.

SPECTRAL PROCEDURES

REFER ALSO TO CITATION(S) 52492, 52493, 52502, 52503, 52504, 52779, 53478

53479 (Y/DK—231) **Determination of meta-phenylenediamine in air by collection on acid-coated silica gel and spectrophotometric measurement as an azo dye derivative.** Williams, N.J.; Van Hook, S.J. III. (Oak Ridge Y-12 Plant, TN (USA)). Jun 1979. Contract W-7405-ENG-26. 17p. P 02/MF A01.

Meta-phenylenediamine (MPDA), an aromatic-amine curing agent, is one of the volatile components of a heat-cured, epoxy-resin system used in the Y-12 Plant. An analytical procedure was developed for monitoring the MPDA concentration in the work-area atmosphere for employee protection. The MPDA is collected on sulfuric-acid-coated silica gel as a sulfate salt. The MPDA salt is then rinsed from the silica gel with 3.6 N H_2SO_4, diazotized with sodium nitrite, and coupled with N-1-naphthylethylenediamine (NEDA) to form an azo dye which is measured spectrophotometrically at 520 nm.

53480 Electron spin resonance study of the radical anions of substituted cyclooctatetraenes: the effects of Jahn—Teller distortions and vibronic mixing. Hammons, J.H. (Swarthmore College, PA); Bernstein, M.; Myers, R.J. *J. Phys. Chem.;* **83**: No. 15, 2034-2040(26 Jul 1979).

The radical anions of methyl-, methoxy-, fluoro-, cyclopropyl-, and cyanocyclooctatetraene were generated by electrolytic reduction of the neutral compounds in liquid ammonia. The electron spin resonance spectrum of each radical anion is assigned, and a clean even—odd alternation of the spin densities is observed in each. This alternation can be correlated with the electronic properties of the substituent. For the radical anions of methyl-, methoxy-, and cyclopropylcyclooctatetraene, the temperature dependence of the coupling constants is reported. The results are accounted for in terms of vibronic mixing and Jahn—Teller distortions, and are discussed in relation to INDO calculations. 3 figures, 7 tables.

SEPARATION PROCEDURES

REFER ALSO TO CITATION(S) 52638, 52645

53481 System for loading slab-gel holders for electrophoresis separation. Anderson, N.G.; Anderson, N.L. (to Department of Energy, Washington, DC). US Patent Application 889,691. 24 Mar 1978. 14p.

A slab-gel loading system includes a prismatic chamber for filling a plurality of slab-gel holders simultaneously. Each slab-gel holder comprises a pair of spaced apart plates defining an intermediate volume for gel containment. The holders are vertically positioned in the chamber with their major surfaces parallel to the chamber end walls. A liquid inlet is provided at the corner between the bottom and a side wall of the chamber for distributing a polymerizable monomer solution or a coagulable colloidal solution into each of the holders. The chamber is rotatably supported so that filling can begin with the corner having the liquid inlet directed downwardly such that the solution is gently funneled upwardly, without mixing, along the diverging side and bottom surfaces. As filling proceeds, the chamber is gradually rotated to position the bottom wall in a horizontal mode. The liquid filling means includes a plastic envelope with a septum dividing it into two compartments for intermixing two solutions of different density and thereby providing a liquid flow having a density gradient. The resulting gels have a density gradient between opposite edges for subsequent use in electrophoresis separations.

INORGANIC AND PHYSICAL CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 53403, 53436, 53445, 53511

53482 (CONF-781063—6) **Potential measurements in acetylide-containing melts.** Qafisheh, J.; Selman, J.R. (Illinois Inst. of Tech., Chicago (USA). Dept. of Chemical Engineering). 1978. Contract EG-77-S-02-4445. 3p. P 02/MF A01.

From 2. symposium on molten salts; Pittsburgh, PA, USA (15 Oct 1978).

Present data suggest that the free energy of formation of Li_2C_2 is -26 kcal/mol at 700°K. However, there is no evidence that the discharge of acetylide ions is reversible, i.e., that acetylide ions are formed by direct reduction of carbon. The carbon electrode is susceptible to mixed potentials. Acetylide ion discharge is strongly diffusion controlled. It appears that acetylide ions in LiCl—KCl eutectic are reasonably stable only in the absence of oxidants such as lithium-intercalated graphite. (DLC)

53483 (CONF-790641—8) **New approaches to the study of lanthanide/actinide chloride: aluminum chloride vapor phase complexes.** Peterson, E.J.; Caird, J.A.; Carnall, W.T.; Hessler, J.P.; Hoekstra, H.R.; Williams, C.W. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 8p. P 02/MF A01.

From Rare earth research conference; Fargo, ND, USA (25 Jun 1979).

The spectrophotometric technique for vapor density measurements of complexed metal ions has been reformulated to account for temperature dependent effects and multi-species systems. Analysis of vapor pressure information indicates that the $NdCl_3$—$AlCl_3$ and $HoCl_3$—$AlCl_3$ systems are adequately explained by the existence of three vapor species. The two higher molecular weight complexes $LnAl_4Cl_{15}$ and $LnAl_3Cl_{12}$ were first proposed by Oeye and Gruen. The newly identified higher temperature species, $HoAl_2Cl_9$, contributes significantly to the vapor density above 750°K and below 3 atm of dimer pressure. In view of the consistency of the Nd^{+3} and Ho^{+3} chemistry the data for the Sm^{+3} system should be viewed with reservation. A new method for vapor density measurements involving use of radioactive tracers has been discussed in terms of its applicability to the study of (Ln,An)Cl_3($AlCl_3$)/sub x/ systems.

53484 (CONF-790658—7) **Photoelectron spectra of trinuclear metal cluster complexes.** Trogler, W.C.; Berkowitz, J. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 4p. P 02/MF A01.

From 27. annual conference on mass spectrometry and allied topics; Seattle, WA, USA (3 Jun 1979).

The photoelectron spectra of Re_3Cl_9, $Ru_3(CO)_{12}$, and $Os_3(CO)_{12}$ were studied. Probable molecular structures in the vapor phase are discussed. (DLC)

53485 (CONF-790658—8) **PES of higher temperature vapors.** Berkowitz, J.; Batson, C.H. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 4p. P 02/MF A01.

From 27. annual conference on mass spectrometry and allied topics; Seattle, WA, USA (3 Jun 1979).

Two types of spectra were obtained on lithium halides, one with essentially the saturated vapor, the other with superheated vapor. Dimer and monomer spectra were derived. The first ionization potential (IP) of dimer is higher than that of monomer in each lithium halide. Calculations predict that trimer has lower IP than dimer, and tetramer has higher IP than trimer. Electron impact measurements on LiF agree with this oscillatory trend, through trimer. A crude ionic model calculation can also rationalize this behavior (assuming hexagonal trimer and distorted cube for tetramer).

53486 (COO—2873-3) **Theory of chemical kinetics. Progress report, January 16, 1978-January 15, 1979.** Ross, J. (Massachusetts Inst. of Tech., Cambridge (USA)). Jan 1979. Contract EY-76-S-02-2873. 10p. P 02/MF A01.

The Franck-Condon approximation was applied to chemical dynamics with success. It was used to study angular distributions of reaction products in atom-diatom reactions. Long-range transitions in stochastic models were considered. The hydrodynamic stability of

stationary and oscillatory convection in binary fluids was studied. Efficiency of thermal engines was also studied. (DLC)

53487 (COO—4254-2) **Properties of supported metal catalysts. Progress report, April 1—June 30, 1979.** Burwell, R.L. Jr.; Butt, J.B.; Cohen, J.B. (Northwestern Univ., Evanston, IL (USA)). Mar 1979. Contract EG-77-S-02-4254. 25p. P 02/MF A01.

The preparation and characterization of supported platinum catalysts has been extended to a series of alumina-supported catalysts similar to the previously investigated platinum—silica series. Characterization has been carried out via hydrogen chemisorption, hydrogen—oxygen titration, hydrogenolysis of methylcyclopropane and deuterium exchange with cyclopentane. In all, some twenty catalysts, with platinum percentage exposed ranging from 4.1 to 103% have been prepared and characterized. As was the case for the silica supported platinum, the specific conditions of catalyst pretreatment have been found to affect substantially the structure sensitive behavior in all cases. In addition, the thermal conditions employed in catalyst preparation affect the nature of structure sensitive behavior, which was not the case for Pt/SiO_2. Substantial effort has been devoted to the development of a suitable system for making x-ray measurements in controlled atmospheres. Several of the Pt/SiO_2 catalysts have been investigated in hydrogen atmospheres, with the curious result that the apparent loading of metal detected in hydrogen is lower than that determined in air (which agreed with the value determined in preparation).

53488 (FE—2408-6) **Study of the mechanism of the hydrogen sulfide/dolomite reaction. Quarterly report, October 1977—December 1977.** Li, K.; Rogan, F.H. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Chemical Engineering). Jan 1978. Contract EX-76-C-01-2408. 25p. P 02/MF A01.

New rate data are reported for the half-calcination of Guelph dolomite (BCR 1337). The reaction rate is practically independent of the total pressure, CO_2 concentration, and pellet size. Data from any given run can be fitted within estimated uncertainties to a semi-empirical conversion vs. time expression similar to one derived for certain solid-solid transformations. Collection of sulfidation and carbonation data was hampered by a breakdown of the microbalance mechanism caused by H_2S corrosion. Repairs have been made and, after modification of the experimental system to prevent recurrence of such failures, data collection will resume at an accelerated pace. Kinetic model development has begun on schedule. Sulfidation rate data can be fit to a shrinking unreacted core model with either chemical reaction or combined gas film transport/product layer diffusion as the rate-controlling step, illustrating the necessity of basing model development on structural observations.

53489 (FE—2408-7) **Study of the mechanism of the hydrogen sulfide/dolomite reaction. Quarterly report, January 1978—March 1978.** Li, K.; Rogan, F.H. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Chemical Engineering). Apr 1978. Contract EX-76-C-01-2408. 29p. P 03/MF A01.

New rate and structure data are presented for the sulfidation of Guelph dolomite. The reaction time for a given conversion is practically independent of reactant gas flow rates, but decreases with increasing temperature or decreasing pellet size. Composition profiles of partially reacted samples, obtained by EDAX, show a diffuse interface separating a product layer from an unreacted core. A kinetic model, intended to represent the reaction behavior at the pellet level, is presented as a basis for the development of a detailed model to describe the reaction behavior at the grain level. Results of the first carbonation experiments are also presented. Both compacted pellets of pure CaS and previously sulfided samples of Guelph dolomite were used. Although no detailed composition profiles have as yet been determined, microscopic examination of polished sections of partially sulfided samples suggests that the reaction proceeds in a topochemical fashion.

53490 (GEPP-TIS—446) **Calcium chromate process related investigations.** Dillard, B.M. (General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.). 29 Aug 1979. Contract EY-76-C-04-0656. 39p. P 03/MF A01.

A pilot plant for production of calcium chromate has been scaled up to a small production facility at the General Electric Neutron Devices Department. In preparation for this scale-up, the process and final product were studied in order to evaluate problems not considered previously. The variables and processes studied included: (1) the determination of optimum drying temperature and time for product analysis; (2) the effect of the grade of lime used as the precipitating agent on the purity of the calcium chromate; (3) product purity when calcium chromate is precipitated by the addition of ammonium chromate to slaked lime; (4) the reagents best suited for cleaning calcium chromate spills; and (5) methods for determining hydroxide ion concentration in calcium chromate. The optimum drying time for the product before analysis is four hours at 600°C. Gases evolved at various temperatures during the drying process were carbon dioxide and water vapor. Technical grade lime produced calcium chromate of the highest purity. Both nitric and acetic acids were efficient dissolvers of calcium chromate spills. Direct titration of hydroxide ion with sulfuric acid gave an average recovery of 93% for samples spiked with calcium hydroxide. 1 figure, 17 tables.

53491 (MLM—2638) **Optimization algorithm.** Silver, G.L. (Mound Facility, Miamisburg, OH (USA)). 24 Aug 1979. Contract EY-76-C-04-0053. 13p. P 02/MF A01.

An abbreviated simplex algorithm suitable for the programmable pocket calculator is applied to chemical equilibrium problems, including the problem of locating the inflection point in the potentiometric titration of plutonium.

53492 **Binuclear complexes of macrocyclic ligands: electrochemical and spectral properties of homobinuclear Cu/sup II/Cu/sup II/, Cu/sup II/Cu/sup I/, and Cu/sup I/Cu/sup I/ species including an estimated intramolecular electron transfer rate.** Gagne, R.R.; Koval, C.A.; Smith, T.J.; Cimolino, M.C. (California Inst. of Tech., Pasadena). *J. Am. Chem. Soc.;* **101**: No. 16, 4571-4580(1 Aug 1979).

Electrochemical techniques were employed to study electron transfer properties of a binuclear copper—macrocyclic ligand complex and to prepare several reduced derivatives. The complex, Cu/sup II/Cu/sup II/$L(ClO_4)_2.2H_2O$, was prepared by condensing 1,3-diaminopropane with 5-methyl-2-hydroxyisophthalaldehyde and $Cu(ClO_4)_2.6H_2O$. The Cu/sup II/Cu/sup II/ complex was reduced in successive, quasi-reversible, one-electron steps at - 0.52 and - 0.91 V vs. NHE. Constant-potential electrolysis was employed to prepare the reduced species, Cu/sup II/Cu/sup I/$L(ClO_4)$ and Cu/sup I/Cu/sup I/L, both of which were isolated and fully characterized. The mixed-valence species, Cu/sup II/Cu/sup I/L^+, is stable in oxygen-free solutions (conproportionation constant: 3.97×10^6) and reacts with carbon monoxide to form an adduct, Cu/sup II/Cu/sup I/$L(CO)ClO_4$. The diamagnetic Cu/sup I/Cu/sup I/L species was obtained as essentially insoluble black needles which, however, formed a soluble dicarbonyl adduct, Cu/sup I/Cu/sup I/$L(CO)_2$, on exposure to CO. The latter complex was not isolated. At the ambient temperature Cu/sup II/Cu/sup I/L^+ exhibits an isotropic seven-line solution EPR spectrum while an anisotropic pattern was observed in frozen solutions (77°K), with four lines for g parallel to and unresolved g perpendicular to. Variable-temperature experiments indicated coalescence at about 200°K suggesting an intramolecular electron transfer rate of about $1.7 \times 10^{10}\ s^{-1}$ at 298°K. Electronic absorption spectral measurements revealed at least two absorptions for Cu/sup II/Cu/sup I/$L(ClO_4)_2$ at 1700 and 1200 nm (CH_2Cl_2), which are not present in Cu/sup II/Cu/sup II/$L(ClO_4)_2.2H_2O$, Cu/sup I/Cu/sup I/L, or the carbonyl derivatives. The new spectral bands may be attributable to intramolecular electron transfer processes. 11 figures, 5 tables.

53493 (ANL-Trans—1168) **Method of preparing cadmium niobate by a solid state reaction.** Shimada, K. Jun 1979. Translation of . Japanese Patent 26109-1971. 5p. P 02/MF A01.

An additive is used to suppress the CdO vaporization during the production of $Cd_2Nb_2O_7$ by a solid-state reaction of the 2 CdO—Nb_2O_5 or 2 $CdCO_3$—Nb_2O_5 system. The additive is $MgCO_3$, $Mg(OH)_2$, or MgO in an amount giving 0.1 to 5%, and the reaction is carried out at 1000 to 1300°C. (DLC)

53494 **Structures of transition-metal hydride complexes.** Bau, R. (Univ. of Southern California, Los Angeles); Teller, R.G.; Kirtley, S.W.; Koetzle, T.F. *Acc. Chem. Res.;* **12**: No. 5, 176-183(May 1979).

This review article is largely concerned with the efforts to gather structural information on hydrogen bridge bonds with neutron diffraction data. 11 figures, 1 table.

53495 (ANL-Trans—1175) **Out-of-pile studies of cesium with UO_2, PuO_2, and $(U,Pu)O_2$.** Lorenzelli, R.; Le Dudal, R.; Atabeck, R. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Apr 1979. Translation of IAEA-SM—236/87. (CONF-790111—7(Trans)). 33p. P 03/MF A01.

From International symposium on thermodynamics of nuclear materials; Julich, F.R. Germany (29 Jan 1979).

Purpose of the experiments is to discover the nature of the compounds (U—Cs—O) and (U—Pu—Cs—O) stable under low oxygen potential, as well as the O/M ratio of the matrix in equilibrium with these compounds. The initial stoichiometry of the oxide (in the shape of dense pellets) was varied and the reactions produced in a closed system (sealed nickel tube) with or without an excess of metal cesium. The progress of the cesium-oxide reaction as a function of time is observed by radiography of the reaction tubes after 24, 50, and 300 h between 600 and 1100°C. The reaction consumes cesium and results in a swelling of the pellets. The identification of the phase is accomplished by x-ray diffraction, micrography and chemical analysis. UO_2—Cs System: a phase diagram after rapid cooling to room temperature was obtained in (1) UO_2—$Cs_2U_4O_{12}$—Cs_2UO_4, (2) UO_2—Cs_2UO/sub 4-x/, and (3) UO_2-x-Cs. The phase x seems to be identical to the one observed by Aitken, but with the formula Cs_8UO_6. PuO_2—Cs System: under low partial pressures of oxygen, no plutonate is obtained; on the contrary, under pressure at

about 400°C, some isomorphous uranate compounds have been identified ($Cs_2Pu_4O_{13}$, Cs_4PuO_4). $(U,Pu)O_2$—Cs System: in the presence of free cesium, the $Cs_2M_4O_{12}$ phase is in equilibrium with MO_2 and, in this phase, the presence of Pu is probable; further, in the presence of an excess of Cs, the dissociation of the oxide mixture with the appearance of PuO_2 has not been observed. The O/M ratio of the matrix MO_2 corresponds to a slightly sub-stoichiometric oxide, that is, 1.997 +- 0.001. Addition of Rb to Cs in variable proportions has no appreciable effect on the reduction limit. This reduction limit seems confirmed by experiments (UO_2, PuO_2, Cs) simulating the dissociation of PuO_2 observed in reactor. Results of this investigation show that in irradiated fuel, the formation of uranate is possible owing to the redistribution of oxygen. (DLC)

53496 Population balance approach to the modeling of solid phase reactions. Bhatia, S.K.; Perlmutter, D.D. (Univ of Pa, Philadelphia). *AIChE J.;* **25**: No. 2, 298-306(Mar 1979).

A population balance approach is used to model solid phase reactions in terms of nuclei of the product phase dispersed in the reactant matrix. A conversion-time relationship is obtained by the solution of a set of moment equations derived from the population balance. Some previously known solutions for both homogeneous and heterogeneous nucleation are developed by this approach to demonstrate the relative ease of solution when compared with previously used integral techniques. A model for nucleus impingement at low conversions is formulated and applied to published data on the oxidation of cuprous iodide to illustrate the practical use of this technique. The classical Avrami model is modified to include the initial volume of a nucleus, and it is shown that insensitivities in the original model are removed by this improvement. The need for direct measurements of nucleation and growth rates is emphasized. 28 refs.

ISOTOPE EFFECTS

REFER ALSO TO CITATION(S) 53483

ORGANIC CHEMISTRY

REFER ALSO TO CITATION(S) 52467

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 52468, 52469, 52477, 52496, 53480

53497 (CONF-790658—1) **Some aspects of the unimolecular decarbonylation reaction of $C_7H_7O^+$ cations.** Russell, D.H.; Canada, D.C.; McBay, E.H. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 2p. P 02/MF A01.

From 27. annual conference on mass spectrometry and allied topics; Seattle, WA, USA (3 Jun 1979).

This study investigated the unimolecular reaction chemistry of a number of $C_7H_7O^+$ ions generated from a variety of precursor molecules, e.g., the cresols, substituted benzyl alcohols, and substituted alkyl phenyl ethers. As a model for the heteroatom tropylium ion, the $C_7H_7O^+$ ion was generated via hydrogen atom loss from the molecular ion of 3,5-cycloheptadienone. The results for metastable kinetic energy release measurements are consistent with different structures for the decomposing $C_7H_7O^+$ ions.

53498 (CONF-790658—5) **Photoelectron spectroscopy of phthalocyanine vapors.** Berkowitz, J. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 2p. P 02/MF A01.

From 27. annual conference on mass spectrometry and allied topics; Seattle, WA, USA (3 Jun 1979).

The He(I) photoelectron spectra of several metal phthalocyanines and metal-free phthalocyanine vapor shows that: a sharp peak at 4.99 eV is an artifact due to ionization of atomic He by He(II) radiation; the first phthalocyanine peak (metal-containing or metal-free) occurs at 6.4 eV; and the metal-like d orbitals lie at least 1 to 2 eV deeper, except in the case of Fe. (DLC)

53499 (COO—2945-2) **Continuous chemical reaction chromatography. Progress report, 15 January 1978—1 February 1979.** Aris, R.; Carr, R.W. Jr. (Minnesota Univ., Minneapolis (USA). Dept. of Chemical Engineering and Materials Science). Jan 1979. Contract EY-76-S-02-2945. 32p. P 03/MF A01.

Construction of a packed, annular cylindrical apparatus with rotating inlet for continuous reaction chromatography was completed. It is being used to investigate the room temperature acid-hydrolysis of methyl formate. Adsorption isotherms for methyl formate, methanol and formic acid on charcoal, the bed packing, were measured. Radial dispersion effects were tested for pure components. Construction of a second apparatus is nearing completion. It is a rotating, packed, cylindrical annulus with fixed inlet, designed for study of catalytic gas phase decompositions at elevated temperatures. A theoretical investigation of a reversible isomerization of type A reversible B in a counter current chromatographic reactor was done.

53500 (IS-T—860) **Pulse and multiple pulse N.M.R. studies of crystallinity and molecular dynamics of solid state polymers.** Paff, A.J. (Ames Lab., IA (USA)). May 1979. Contract W-7405-ENG-82. 64p. P 04/MF A01.

Pulse and multiple pulse N.M.R. techniques were used to study polypropylene and polyethylene. The degree of crystallinity of two polypropylene samples was investigated by analyzing the time decays of a simple $\pi/2$ pulse and the more complex eight-pulse cycle. The single pulse experiment gives the superposition of two decays, the short component being attributed to the rigid region while the long component to the mobile region. Heating of the samples to 88°Cproduced a situation where the rigid and mobile regions become synonymous with the crystalline and noncrystalline regions. The eight pulse cycle will only average the homonuclear dipole-dipole interactions, H/sub D/, only at observation times nt/sub c/, when the criteria t/sub c/ absolute value of H/sub D/ $<<$ 1 is met. With the selection of the appropriate cycle time, t/sub c/, of 72 μs only the magnetization of the noncrystalline region will be monitored. The application of the eight pulse cycle, seventeen pulse cycle, -M/sub x/ phase pull sequence, and P/sub x/ - M/sub y/ phase pull sequence allowed for a variety of interaction Hamiltonians of polyethylene to be investigated.

53501 Systematics in the electronic spectra of polar molecules. 2. Ortho- and meta-disubstituted benzenes. Findley, G.L.; Carsey, T.P.; McGlynn, S.P. (Louisiana State Univ., Baton Rouge). *J. Am. Chem. Soc.;* **101**: No. 16, 4511-4516(1 Aug 1979).

The absorption and emission properties of ortho- and meta-disubstituted benzenes, one substituent being an electron acceptor and the other an electron donor, are discussed from computational (CNDO/s) and experimental points of view. It is found that E(^{1}L/sub a/) or E(^{1}L/sub b/) serves to parametrize the degree of charge transfer in the respective states. Unlike the para isomers, E(^{1}L/sub a/) - E(^{1}L/sub b/) is always positive and approximately 10,000 cm^{-1}. The T_1 state is always ^{3}L/sub a/. The gamut of properties which are mediated by an increasing degree of charge transfer are elaborated and are interpreted (and also interrelated with those of the para isomers) using the computational data. Particular attention is paid to the interrelationship of emissive and absorptive properties. It is found that ^{1}L/sub b/$/\!/^1$CT mixing in the ortho and meta isomers induces considerable dipole allowedness in their ^{1}L/sub b/ states whereas the same mixing in the para isomer is much less efficient in conferring dipole allowedness on its ^{1}L/sub b/ state. 8 figures, 5 tables.

53502 Reaction of a bridged binuclear dialkylcobalt complex with carbon monoxide and phosphines: observation of competing inter- and intramolecular metal to metal methyl transfer. Lyerla, J.R. (IBM Research Lab., San Jose, CA); Yannoni, C.S.; Bruck, D.; Fyfe, C.A. *J. Am. Chem. Soc.;* **101**: No. 16, 4766-4772(1 Aug 1979).

This study emphasizes that, even when organometallic reactions are kinetically well-behaved and give one product in quantitative yield, it is critically important to carry out crossover experiments to test their intramolecularity. In this case such experiments, combined with the specific nature of the transformation involved, have allowed the authors to delineate especially sharply the mechanism of a carbon—carbon bondforming reaction mediated by a binuclear organotransition metal complex. 1 figure, 1 table.

53503 Phase behavior of alcohol—hydrocarbon—brine mixtures. Knickerbocker, B.M.; Pesheck, C.V.; Scriven, L.E.; Davis, H.T. (Univ. of Minnesota, Minneapolis). *J. Phys. Chem.;* **83**: No. 15, 1984-1990(26 Jul 1979).

Ten monohydric alcohols (methanol through tert-amyl alcohol), representing a class of amphiphiles that contrast surfactants which efficiently solubilize hydrocarbon and brine, were mixed with equal volumes of hydrocarbons and brine of various salinities. The resulting multiphase mixtures were examined for the number of coexisting liquid phases and the partitioning of the alcohol among them. The patterns of phase behavior are similar to those observed with amphiphiles classified as surfactants. The dependence on salinity, hydrocarbon character, and temperature is similar also. The patterns of phase behavior in the alcohol systems may be characteristic of all amphiphile—hydrocarbon—brine systems. 5 figures, 5 tables.

53504 Hydroaromatic hydrogenation/dehydrogenation. Gangwer, T.; MacKenzie, D.; Casano, S. (Brookhaven National Lab., Upton, NY). Contract EV76-C-02-0016. *J. Phys. Chem.;* **83**: No. 15, 2013-2015(26 Jul 1979).

The kinetics of the tetralin/1,2-dihydronaphthalene/naphthalene system in the gas phase were studied. The reactions were found to be heterogeneous and followed zero-order rate laws. The rate constants measured at 400°C for initial tetralin conversion to 1,2-dihydronaphthalene plus hydrogen and for initial 1,2-dihydronaphthalene conversion to naphthalene plus hydrogen were 2.3 x 10^{-14} and

6.3 x 10^{14} mol/cm^2s, respectively. A heterogeneous mechanistic model is proposed for the system. 2 figures, 1 table.

ISOTOPE EXCHANGE AND ISOTOPE SEPARATION

REFER ALSO TO CITATION(S) 53507

ELECTROCHEMISTRY

REFER ALSO TO CITATION(S) 53492

53505 (COO—4445-T1) **Electrochemistry of acetylides, nitrides and carbon cathodes in molten halides.** Selman, J.R. (Illinois Inst. of Tech., Chicago (USA). Dept. of Chemical Engineering). May 1979. Contract EG-77-S-02-4445. 9p. P 02/MF A01.

The ΔG/sub f/ of Li_2C/sub x/ and CaC/sub x/ were determined to be -47.02 kcal/mole at 700°K and -31.44 kcal/mole at 823°K, respectively. They confirm that the potential of carbon electrodes in acetylide melts is a mixed potential, governed by lithium or calcium intercalation simultaneously with acetylide-ion discharge: $Li^+ + x\ C \rightarrow LiC/sub\ x/ -e^-$, and $C_2^{2-} \rightarrow 2C + 2e^-$. (DLC)

PHOTOCHEMISTRY

REFER ALSO TO CITATION(S) 53513

53506 (COO—2807-16) **Experimental investigation of the chemistry of excited states of rare gases. First quarterly progress report, 15 October 1978—15 January 1979.** Setser, D.W. (Kansas State Univ., Manhattan (USA). Dept. of Chemistry). Mar 1979. Contract EY-76-S-02-2807. 9p. P 02/MF A01.

Analysis of XeF(B) and XeF(C) state quenching from photodissociation of XeF_2 was continued and progress was made on reactive quenching of the resonance states, $Xe(^3P_1)$ and $Kr(^3P_1)$. The study of the reactions of the resonance states of the rare gases was concentrated on the $Kr^* + Cl_2$ reaction.

53507 **Photolytic separation of carbon isotopes in cryogenic solutions of carbon disulfide.** Freund, S.M.; Maier, W.B. II; Holland, R.F.; Beattie, W.H. (Univ. of California, Los Alamos, NM). *J. Am. Chem. Soc.;* **101**: No. 16, 4522-4524(1 Aug 1979).

We report the separation of carbon isotopes by photolysis of CS_2 in cryogenic solutions of nitrogen, krypton, and argon with 206-nm light from an iodine resonance lamp. The spectral distribution of the ultraviolet absorption depends on solvent. Thus, in liquid nitrogen the photolytic rate of $^{13}CS_2$ is greater than that of $^{12}Cs_2$ whereas in liquid krypton and liquid argon the reverse is true. 4 figures, 1 table.

53508 **Photophysical and photochemical properties of rhodium(III) halopentaammine complexes in aqueous solution: reaction kinetics of ligand field excited states.** Bergkamp, M.A.; Brannon, J.; Magde, D.; Watts, R.J.; Ford, P.C. (Univ. of California, Santa Barbara). *J. Am. Chem. Soc.;* **101**: No. 16, 4549-4554(1 Aug 1979).

Reported are the photoluminescence spectra, lifetimes and quantum yields, and ligand photosubstitution reaction quantum yields for the rhodium(III) complexes $Rh(NH_3)_5Cl^{2+}$ and $Rh(NH_3)_5Br^{2+}$ and their perdeuterated analogues in ambient temperature aqueous solution. When combined with the conclusions based on earlier sensitization studies that intersystem crossing/internal conversion to the lowest energy ligand field states occurs with approximately unitary efficiency, these results allow calculation for the first time of the individual rate constants for the radiative, nonradiative, and reactive deactivation pathways from these excited states for a d^6 complex under photochemically relevant conditions. The perdeuterio complexes demonstrated higher quantum yields for both photosubstitution and photoemission than their perprotio analogues, a result which can be attributed to reduction of the nonradiative deactivation rate constants in the former cases. The correspondence between deuteration effects on excited-state lifetimes and on photoreaction quantum yields indicates that chemical reaction is directly competitive with the other deactivation pathways of the ligand field excited state. Lastly, comparison of the excited state ligand substitution rate constants with those of analogous thermal reactions indicates the excited state reactions to be the faster by 14 to 15 orders of magnitude. 2 figures, 4 tables.

53509 **Infrared photolysis of methyl isocyanide.** Hicks, K.W.; Lesiecki, M.L.; Riseman, S.M.; Guillory, W.A. (Eastern Michigan Univ., Ypsilanti). Contract ER-78-02-4695. *J. Phys. Chem.;* **83**: No. 15, 1936-1939(26 Jul 1979).

The infrared (ir) multiple-photon photolysis of CH_3NC has been performed over the range 10 mtorr to 1.0 torr by using the 10.696-μm line of a TEA CO_2 laser. The rotational and vibrational temperatures of $CN(X^2\Sigma^+)$, resulting from the photolysis of CH_3NC, are hotter than those obtained in the ir photolysis of CH_3CN. Experiments which involved the time evolution of CH, CN, and C_2 along with stable product analysis have provided the basis for the possible mechanisms by which these species are formed. The major process of CH_3NC conversion with the 10.696-μm line appears to be isomerization to CH_3CN and subsequent secondary photolysis of vibrationally excited CH_3CN, which also absorbs the 10.696-μm line. Stable product analyses at pressures between 10 and 40 torr revealed the presence of C_2H_2, HCN, and CH_3CN. 2 figures, 1 table.

53510 **Vacuum ultraviolet photochemistry of trimethylene sulfone and cyclobutanone: the triplet trimethylene diradical.** Scala, A.A.; Colon, I. (Worcester Polytechnic Inst., MA). Contract EY-76-S-02-3569. *J. Phys. Chem.;* **83**: No. 15, 2025-2028(26 Jul 1979).

Trimethylene sulfone has been photolyzed at 147.0, 123.6, and 106.7—4.8 nm in the gas and solid phases. The primary products of photolysis at all wavelengths are SO_2, cyclopropane, propylene, and ethylene. The major reaction of excited trimethylene sulfone is elimination of SO_2 to produce trimethylene diradical. At 147.0 nm a triplet state is implicated in the photodecomposition, while at 106.7—4.8 nm there is no evidence for the production of a triplet in the gas-phase photolysis. The similarity to the vacuum uv photochemistry of cyclobutanone is also examined. 1 figure, 4 tables.

53511 **Non-equilibrium phenomena in the kinetics of photochemical ozone production.** Kozak, J.J.; Nicolis, G.; Kress, J.W.; Sanglier, M. (Univ. of Notre Dame, IN). *J. Non-Equilib. Thermodyn.;* **4**: No. 2, 67-74(1979).

A sequence of photochemical reactions of interest in atmospheric physics is considered. Mass and energy-balance equations are derived and studied both analytically and numerically. It is shown that under certain conditions the approach to the steady state is characterized by considerable overshoots in the composition variables and in the temperature.

RADIATION CHEMISTRY

REFER ALSO TO CITATION(S) 53717

53512 (COO—3221-59) **Decay of peroxy radicals of methanol and isopropanol in the presence of copper ions and superoxide dismutase. Progress report, December 1, 1978—November 30, 1979.** Ilan, Y.A.; Ilan, Y.; Czapski, G. (Hebrew Univ., Jerusalem (Israel). Dept. of Physical Chemistry). 1979. Contract EY-76-C-02-3221. 6p. P 02/MF A01.

The decay of the peroxy radicals produced from methanol and isopropanol was followed in the presence and in the absence of Cu^{2+} ions, and the enzyme Superoxide Dismutase. The results indicate that both Cu^{2+} and Superoxide do not affect the decay of the alcohol peroxy radicals. They catalyze the decay of O^-_2 radicals which are formed from the alcoholic peroxy radicals, and which absorb light at the same wavelengths region as these radicals. This catalysis enables the resolution of the decay of the alcoholic peroxy radicals, without the interference of absorption changes originating in the decay of HO_2 and O^-_2 radicals.

53513 (COO—3221-60) **Nature of oxygen containing radicals in radiation chemistry and photochemistry of aqueous solutions. Annual progress report, September 1978—July 1979.** Czapski, G. (Hebrew Univ., Jerusalem (Israel). Dept. of Physical Chemistry). 1979. Contract EY-76-C-02-3221. 42p. P 03/MF A01.

The proposed research is a continuation of the work conducted under this contract and is outlined. During this year, the main emphasis will be given to study further the properties of HO_2 and O_2^- and OH, mainly in their role in biological systems. We will continue to study and elucidate how O_2^- reacts in biological systems. The toxicity of O_2^- is quite well established, but the mechanism is still obscure. The Haber Weiss reaction most probably can not account for the toxicity of O_2^- nor for the formation of singlet oxygen, nor of OH. We will study if reduction of Fe^{3+} complexes by O_2^- in biological systems does catalyze the Haber Weiss reaction and if OH is formed in this mechanism. The role of oxygen, radiosensitizers in radiation damage of bacteriophages and cells will be further studied, as well as on E. Coli and Enzymes. We will try to elucidate the formation and role of OH, O_2^- and O_2 in these systems as well as the relative contribution of endogenous and exogenous damage, and the role of direct and indirect radiation damage to cells. We intend also to study if SOD (super oxide dismutase) does react only with O_2^- or also with biological peroxides (RO_2) and Hydroperoxides (RO_2H). Further studies of O_2^- and O_2 with various cytochromes, and hemoglobins is planned.

53514 (ORO—3106-71) **Radiation chemistry of hydrocarbon and alkyl halide systems. Progress report, August 1, 1978-August 30, 1979.**

Hanrahan, R.J. (Florida Univ., Gainesville (USA)). 1979. Contract EY-76-S-05-3106. 23p. P 03/MF A01.

Deactivation of excited atomic iodine in the $^2P/sub\ 1/2/$ state was studied. Products of γ radiolysis of Co-H_2 were identified. A study on the photolysis of CF_3I-CH_3I was initiated. (DLC)

53515 (ORO—4062-58) **ELDOR investigations of radiation processes. Annual progress report, 1978-1979.** Kispert, L.D. (Alabama Univ., University (USA). Dept. of Chemistry). 1979. Contract EY-76-S-05-4062. 23p. P 02/MF A01.

Two areas of research are reported on. First, an investigation of the intramolecular and intermolecular relaxation processes in crystals as a function of radical substituent, temperature, intramolecular motion and irradiation history was carried out in order to establish the ELDOR response for each class of radicals. Secondly, these ELDOR results are used to determine the radicals formed (and thus identify the chemical reaction which occurred) when the crystalline lattice is systematically varied.

53516 **Identity and yield of positive charge centers in irradiated chloro hydrocarbon liquids and the rates of their interaction with solute molecules.** Wang, Y.; Tria, J.J.; Dorfman, L.M. (Ohio State Univ., Columbus). Contract EY-76-S-02-1763. *J. Phys. Chem.;* **83**: No. 15, 1946-1951(26 Jul 1979).

Pulse radiolysis studies of the formation kinetics and the yields of various phenylcarbenium ions from several different solutes in 1,2-dichloroethane solution have been carried out. The results indicate that there are two kinetically distinguishable cationic species of the solvent which react selectively with the different solutes to form the phenylcarbenium ions. It is suggested that one is a cation radical (yield 0.68 molecule/100 eV) and the other a carbocation (yield 0.20 molecule/100 eV). Rate constants for their separate reactions with selected aromatic compounds and with ammonia have been determined. Molar extinction coefficients have been estimated for benzyl cation, diphenyl cation radical, and anthracene cation radical. 6 figures, 1 table.

53517 (LA-tr—79-26) **Determination of gaseous products of radiolysis by gas chromatography.** Groh, R.; Mathieu, J. Translated from *Analusis;* **4**: No. 1, 41-46(1976). 11p. P 02/MF A01.

A method of determination of hydrogen and other gaseous components in a sealed ampule by gas chromatography is described. The quantity of each gaseous component is obtained by means of the corresponding area of the chromatographic peak, with previously determined external reference curves; in particular, the volume of the injection sample does not have to be known. The method was applied to determination of the radiochemical yields of the gaseous components formed by irradiation (γ photons from ^{60}Co) of hexane or hexane and carbon tetrachloride mixtures.

RADIOCHEMISTRY AND NUCLEAR CHEMISTRY

PROPERTIES OF RADIOACTIVE MATERIALS

REFER ALSO TO CITATION(S) 52660, 53491

53518 (LA—7948-MS) **Valence instabilities as a possible source of actinide system inconsistencies.** Sandenaw, T.A. (Los Alamos Scientific Lab., NM (USA)). Aug 1979. Contract W-7405-ENG-36. 11p. P 02/MF A01.

The presence of a mixed-valence state in light actinides appears evident from the crystal structures of certain U, Np, and Pu phases. As supporting evidence, the physical property response of these actinide elements (and some of their alloys) is compared with that of rare-earth metallic compounds known to have an unstable valence. Impurities may stabilize an intermediate (different) valence state locally in rare-earth compounds in the presence of the valence state of the bulk phase. Impurity elements from different periodic table groupings may likewise stabilize different intermediate valence states in light actinide elements, thus contributing to inconsistencies in results reported by different experimentalists. Any model (theory) advanced for explaining the physical property behavior of U, Np, and Pu may also require consideration of a configurational limit. A phenomenological connection could exist between a martensitic transformation and the fluctuation temperature in both rare earth and actinide systems.

COMBUSTION, PYROLYSIS, AND HIGH-TEMPERATURE CHEMISTRY

53519 (AD-A—062291) **Ignition, combustion, detonation, and quenching of reactive mixtures. Final report, 1 April 1973-31 March 1978.** Edse, R.; Dhiman, O.P. (Ohio State Univ., Columbus (USA). Dept. of Aeronautical and Astronautical Engineering). Jun 1978. 105p. Y A06/MF A01.

A burner tube having a rectangular cross-section with a width-to-length ratio of approximately 200 has been used for measuring the quenching distances of various fuel oxidizer mixtures by squeezing the flames between two movable plates. For laminar flames the quenching distances were found to be independent of the initial gas speed, the Reynolds number of the flow of unburned gas, and the geometry of the burner port. However, they depend on the material and structure of the quenching surface; the composition of the unburned gas, its thermal conductivity, diffusion coefficient, and specific heats; the adiabatic flame/temperature, and the linear rate of flame propagation. Spectrographic studies revealed that quenching greatly reduces the concentrations of active species in the flame and that the populations of the rotational levels of the CH radical correspond to temperatures which are much higher than the adiabatic flame temperature. A simple mathematical model has been used to develop a theoretical equation for the prediction of quenching distances of various fuel-oxidizer mixtures.

53520 **Laser fluorescence temperature measurements.** Kowalik, R.M.; Kruger, C.H. (Stanford Univ, Calif). *Combust. Flame;* **34**: No. 2, 135-140(Mar 1979).

A laser-induced fluorescence diagnostic capable of local relative temperature measurements in particle-laden combustion flows is described. Results of steady-state experiments conducted with a small laboratory burner are presented, and extensions of the technique for absolute and fluctuating temperature measurements are discussed. 8 refs.

ENGINEERING

GENERAL ENGINEERING

53521 (LA—7919-M) **AT-4 drafting standard.** Cole, T.R. (comp.). (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 41p. P 03/MF A01.

Engineering drawings are highly developed graphic communications that transfer information by the use of symbols having meaning. These symbols combine shape, dimensions, materials, and other characteristics to specify a product, which will perform reliably its required function. The guide provides uniformity in the meaning and use of symbols to improve communications among the persons using engineering drawings. Its standards specify how to put information on drawings; produce uniformity in drafting practices; improve communications with manufacturers; reduce drawing, checking, and supervisory time; and result in a general cost reduction.

FACILITIES AND EQUIPMENT

REFER ALSO TO CITATION(S) 52442, 52448, 53760, 53994

53522 (CONF-7809162—, pp 26p, Paper 2) **Thermal efficiency and production economics of chemical plants.** Gaensslen, H. 1978.

From Workshop on coal liquefaction; Julich, F.R. Germany (18 Sep 1978).

During optimization calculations for the German Ministry for Research and Technology the investment costs of a large number of complex organic plants had to be determined. Doing this in the classic way by estimation proved extremely time-consuming. Therefore, it was desirable to find a calculation method that would yield quickly the investment cost of such a plant requiring at the same time a minimum of data. For this purpose a number of chemical plants, all using organic substances as raw material, were subjected to a statistical analysis in order to find a suitable correlation between investment cost and certain characteristic parameters of the plant. After many failures it was found that investment cost of such chemical plants is related to energy transformation in the process, the result being independent of the internal structure of the plant. As a matter of fact, it is possible to estimate by the method described the investment cost of a chemical plant without even the slightest notion of how the plant is designed; it suffices to know the input and the output of said plant.

53523 (COO—2733-24) **Inelastic analysis of transverse deflection of plates by the boundary element method.** Morjaria, M.; Mukherjee, S. (Cornell Univ., Ithaca, NY (USA). Dept. of Theoretical and Applied Mechanics). Jun 1979. Contract EY-76-S-02-2733. 50p. P 04/MF A01.

A numerical scheme for time-dependent inelastic analysis of transverse deflection of plates of arbitrary shape by the boundary element method is presented. The governing differential equation is

the inhomogeneous biharmonic equation for the rate of small transverse deflection. This complicated boundary value problem for an arbitrarily shaped plate is solved by using a novel combination of the boundary element method and finite element methodology. The number of unknowns, however, depends upon the boundary discretization and is therefore less than in a finite element model. A combined creep-plasticity constitutive theory with state variables is used to model material behavior. The computer code developed can solve problems for an arbitrarily shaped plate with clamped or simply supported boundary conditions and an arbitrary loading history. Some illustrative numerical results for clamped and simply supported rectangular and triangular plates, under various loading histories, are presented and discussed.

53524 (SAND—74-0326) **High current testing of lightning arrestor connectors.** Ehrman, E.F. (Sandia Labs., Albuquerque, NM (USA)). Aug 1979. Contract EY-76-C-04-0789. 47p. P 03/MF A01.

Previous development, TMS and FPU activities established that lightning arrestor connectors (LAC's) utilizing the dielectric stimulated arc concept provided warhead lightning protection. This early development included very few current capability tests in excess of 20 kA. This report describes simulated severe lightning flash current ($\approx$ 200 kA) testing of LAC's (the MC2796 eighteen pin and MC2797 thirty-two pin). The current generator, electrical circuitry, currents, voltages and test results are discussed. The generator provided 3 components (strokes) with 60 milliseconds between strokes. The first component was created by discharging 56 μF charged to 38 kV. The output current was a damped oscillatory wave that had a frequency of 15.6 kHz, resulting in a rise time of 16 μs to the crest of the first half cycle. The current at the first peak was 190 kA. The total charge transferred was 45°C. The second component was created using 140 μF charged to 13.5 kV. The output current wave had a frequency of 8.9 kHz, a rise time of 28 μs to the crest of the first half cycle and a current of 93 kA at the first peak. The total charge transferred was 33°C. The third component was supplied by a three-phase half wave rectifier circuit. The initial peak was 2 kA for 0.02 s. A circuit series resistance was shunted with a fuse resulting in a drop to 357 A when the fuse opened. The 357 A continued for 0.27 s. The total charge transferred was 129°C (total of all components equalling 207°C). Fifty LAC's (25 MC2796 and 25 MC2797) were subjected to the tests. The maximum voltage measured at the solder cup terminals of the LAC's was 1325 V which is well within the specified 2000 V limit. The average was 746 V. Melting of the internal parts (web and pins) occurred. Some burning and melting at the mating connector interface was observed. The LAC'S functioned as required during exposure to the simulated severe lightning flash current.

53525 (SAND—79-0088) **Quality assurance program for PLZT ceramic lenses and associated helmet hardware used with thermal/flash protect device (TFPD).** Balthaser, R.R. (Sandia Labs., Albuquerque, NM (USA)). Mar 1979. Contract EY-76-C-04-0789. 29p. P 03/MF A01.

Sandia Laboratories was authorized by the USERDA on 6 February 1975 to initiate work on a reimbursable program with the USAF Life Support System Program Office, ASD/AELS, located at Wright-Patterson Air Force Base, Ohio. The purpose of the program is to develop PLZT thermal/flash protective devices (TFPD), with primary emphasis on the establishment of a production capability for goggles. In support of the production phase of this project, Quality Assurance Department of Sandia Laboratories was requested to develop a Quality Assurance Program for Sanida procured product. This document defines the Quality Assurance Program.

53526 (SAND—79-0491) **Expansion improvements in compressed magnetic field generator armatures.** Nordstrom, T.V. (Sandia Labs., Albuquerque, NM (USA)). Aug 1979. Contract EY-76-C-04-0789. 44p. P 03/MF A01.

Methods of improving uniform expansion behavior of compressed magnetic field device armatures were studied. Initial microstructure of the copper tubes was altered in a controlled manner using different forming techniques and alloying. Results show a 100% improvement in uniform explosive expansion volume for spun and electroformed copper armatures compared to standard armatures machined from drawn tubing. Expansion improvement has been correlated with changes in the mechanical texture due to forming.

53527 (SAND—79-0984C) **Engineering and economics of lighting for closed circuit television (CCTV) security alarm assessment.** Faucett, R.E.; Schow, F.L. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 36p. (CONF-790916—1). P 03/MF A01.

From Annual IES technical conference; Atlantic City, NJ, USA (15 Sep 1979).

The study examines the economics and applicability of low and high pressure sodium sources in both streetlight and floodlight luminaires for CCTV illumination of high-security areas. In addition the signal outputs of several popular CCTV camera tube types operated in the presence of common lighting sources are calculated. These calculations take into consideration the spectral response of the camera tubes and the spectral output of the light sources. The results are presented in terms of dollars per unit camera signal strength and also camera signal strength per connected watt of electrical load.

53528 (SAND—79-1322C) **Development of a centrifuge to simulate the spin environment of artillery shells containing telemetry.** Kannolt, J.R.; Dunn, D.L. (Sandia Labs., Albuquerque, NM (USA); Trio-Tech International, Burbank, CA (USA)). 1979. Contract EY-76-C-04-0789. 14p. (CONF-790911—1). P 02/MF A01.

From Military electronics defense expo; Wiesbaden, F.R. Germany (25 Sep 1979).

The paper describes a centrifuge and associated equipment developed for active testing of electronic components and assemblies in simulated artillery shell spin environments of up to 20,000 rpm. The centrifuge drive system, spindle and slip ring module, test unit fixturing, rotor orbit monitoring system, and safety features are described.

53529 (UCRL—50025-79-2) **Electronics Engineering Department quarterly report No. 2, 1979.** (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Jun 1979. Contract W-7405-ENG-48. 29p. P 03/MF A01.

Separate abstracts are included for the different research areas concerning electronic systems development.

CRYOGENIC AND SUPERCONDUCTING EQUIPMENT AND DEVICES

REFER ALSO TO CITATION(S) 53548, 53946, 53947

53530 (CONF-790815—12) **Heating-induced flows in cable-in-conduit conductors.** Dresner, L. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 15p. P 02/MF A01.

From Cryogenic engineering conference; Madison, WI, USA (21 Aug 1979).

Hoenig et al and Miller et al have both reported high stability margins for cable-in-conduit conductors cooled by stationary supercritical helium. Miller et al proposed that strong flows induced in the helium in the early stages of recovery enhanced heat transfer and greatly increased the stability margin over what had been expected for stationary helium. In this memorandum, the flow and pressure transients induced in initially stationary helium by energy transfers typical of those associated with conductor recovery (50 to 200 mJ cm^{-3} in 10 to 20 msec) are calculated.

53531 (CONF-790815—14) **Stress effects in a Nb_3Sn conductor proposed for use in the magnetic fusion energy program.** Specking, W.; Easton, D.S.; Kroeger, D.M.; Sanger, P.A. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 19p. P 02/MF A01.

From Cryogenic engineering conference; Madison, WI, USA (21 Aug 1979).

Because of significant interest in multifilamentary Nb_3Sn conductors with copper stabilization for large magnetic devices, knowledge of stress effects on electrical and mechanical properties of such conductors is important. The conductor studied in this experiment is proposed for use as a basic strand material to form a force-cooled cable for the Large Coil Program at ORNL. Stress-strain curves and stress effects on the critical current of differently reacted conductors are presented.

53532 (CONF-790815—16) **Propagation of normal zones in thermally insulated superconductors.** Dresner, L. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 17p. P 02/MF A01.

From Cryogenic engineering conference; Madison, WI, USA (21 Aug 1979).

A comparison of measured and calculated propagation velocities for superconductors thermally insulated by silicon grease shows that the grease makes a significant contribution to the effective specific heat of the conductor and substantially reduces the propagation velocity compared with what would be expected for perfectly insulated conductors.

53533 (LA-UR—79-2422) **Conceptual design of a 20-MJ superconducting forced cooled ohmic-heating coil.** Singh, S.K.; Murphy, J.H.; Janocko, M.A.; Haller, H.E.; Litz, D.C.; Eckels, P.W.; Rogers, J.D.; Thullen, P. (Westinghouse Electric Corp., Pittsburgh, PA (USA); Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 19p. (CONF-790815—11). P 02/MF A01.

From Cryogenic engineering conference; Madison, WI, USA (21 Aug 1979).

Conceptual design of a 20 MJ superconducting coil is described which was developed to demonstrate the feasibility of an ohmic-heating system. The superconductor material was Nb_3Sn for a 9 tesla maximum field. Cabled and braided conductors were investi-

gated and the braided conductors were identified as the best alternates due to their high operating current densities and because of its porosity. The coil was designed to be cryostable for bipolar operation from +9 tesla to -9 tesla maximum field within 1 second. The forced cooled design utilizes cross flow cooling. The coil was designed to generate the flux swing while simultaneously meeting the limitations imposed by cooling, insulation, current density and stresses in the materials.

PROTECTIVE STRUCTURES AND EQUIPMENT

53534 (ORNL/TM—6671) **Tritium protective clothing.** Fuller, T.P.; Easterly, C.E. (Oak Ridge National Lab., TN (USA)). Jun 1979. Contract W-7405-ENG-26. 79p. P 05/MF A01.

Occupational exposures to radiation from tritium received at present nuclear facilities and potential exposures at future fusion reactor facilities demonstrate the need for improved protective clothing. Important areas relating to increased protection factors of tritium protective ventilation suits are discussed. These areas include permeation processes of tritium through materials, various tests of film permeability, selection and availability of suit materials, suit designs, and administrative procedures. The phenomenological nature of film permeability calls for more standardized and universal test methods, which would increase the amount of directly useful information on impermeable materials. Improvements in suit designs could be expedited and better communicated to the health physics community by centralizing devlopmental equipment, manpower, and expertise in the field of tritium protection to one or two authoritative institutions.

HANDLING EQUIPMENT AND PROCEDURES

53535 (RFP—2787) **Method of inspecting Raschig rings by neutron absorption counting.** Morris, R.N.; Murri, R.L.; Hume, M.W. (Atomics International Div., Golden, CO (USA). Rocky Flats Plant). 27 Jul 1979. Contract EY-76-C-04-3533. 11p. P 02/MF A01.

A neutron counting method for inspecting borosilicate glass Raschig rings and an apparatus designed specifically for this method are discussed. The neutron count ratios for rings of a given thickness show a linear correlation to the boron oxide content of the rings. The count ratio also has a linear relationship to the thickness of rings of a given boron oxide content. Consequently, the experimentally-determined count ratio and physically-measured thickness of Raschig rings can be used to statistically predict their boron oxide content and determine whether or not they meet quality control acceptance criteria.

SHIPPING CONTAINERS

53536 (DPSPU—79-124-2) **Supplement to safety analysis report for packaging steel banded wooden shipping containers for slightly enriched uranium metal (NLCO-1107).** Honkonen, D.L. (comp.). (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). Jun 1979. Contract EY-76-C-09-0001. 13p. (DPSP—79-71-6). P 02/MF A01.

A total of 36 tons of slightly enriched uranium metal in the form of Mark VR, VE, and 15 slugs and cores is to be returned to NLO from Building 777-M. The most practical method of shipping this uranium is in the NLO wooden containers in which it was originally received. However, existing shipping regulations were written after this uranium was shipped and the Certificate of Compliance, COC, does not authorize the shipment of this uranium in these boxes and the Safety Analysis Report for Packaging, SARP, does not discuss this uranium. Therefore, this supplement to the SARP is intended to provide the basis for revision of the COC to permit shipping Mark VR, VE and 15 cores and slugs in NLO wooden containers.

53537 (NUREG/CR—0880) **Dynamic analysis to establish normal shock and vibration of radioactive material shipping packages. Quarterly progress report, January 1-March 31, 1979.** Fields, S.R.; Mech, S.J. (Hanford Engineering Development Lab., Richland, WA (USA)). Jul 1979. Contract EY-76-C-14-2170. 71p. (HEDL-TME—79-29). P 04/MF A01.

The objective of the study is to determine the extent to which the shocks and vibrations experienced by radioactive material shipping packages during normal transport conditions are influenced by, or are sensitive to, various structural parameters of the transport system (i.e., package, package supports, and vehicle). The purpose of this effort is to identify those parameters which significantly affect the normal shock and vibration environments so as to provide the basis for determining the forces transmitted to radioactive material packages. Determination of these forces will provide the input data necessary for a broad range of package-tiedown structural assessments.

53538 (NUREG/CR—0930(Pt.1)) **Puncture of shielded radioactive material shipping containers. Part I. Analysis and results.** Larder, R.A.; Arthur, D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Dec 1978. Contract W-7405-ENG-48. 48p. (UCRL—52638(Pt.1)). P 03/MF A01.

Improved analytical methods for predicting puncture of radioactive material shipping containers are reported. Fifty nine static and dynamic puncture tests of lead-backed, uranium-backed, and unbacked flat, circular, stainless steel plates with several mild-steel punch configurations were conducted. It was found that analytical puncture prediction requires two essential elements: (1) a code that will accurately track stress and displacement throughout the event, and (2) a criterion for identifying when and if puncture occurs. (The puncture event is not self-evident from the calculation.) We coupled the NIKE2D finite element code with the puncture criteria - a shear stress criterion for the lead-backed plates and a maximum effective plastic strain criterion for the uranium-backed plates; the results agreed very well with the test data.

53539 (ORNL—5406/R1) **Safety Analysis Report for Packaging (SARP) of the Oak Ridge National Laboratory Shipping Cask D-38. Revision 1.** Box, W.D.; Shappert, L.B.; Seagren, R.D.; Watson, C.D.; Hammond, C.R.; Klima, B.B. (Oak Ridge National Lab., TN (USA)). Sep 1979. Contract W-7405-ENG-26. 129p. P 07/MF A01.

An analytical evaluation of the Oak Ridge National Laboratory Shipping Cask D-38 (solids shipments) was made to demonstrate its compliance with the regulations governing off-site radioactive material shipping packages. The evaluation encompassed five primary categories: structural integrity, thermal resistance, radiation shielding, nuclear criticality safety, and quality assurance. The results of the evaluation show that the cask complies with the applicable regulations.

53540 (ORNL—5408/R1) **Safety Analysis Report for Packaging (SARP) of the Oak Ridge National Laboratory Garden Carrier No. 2. Revision 1.** Box, W.D.; Klima, B.B.; Seagren, R.D.; Shappert, L.B.; Watson, C.D.; Aramayo, G.A. (Oak Ridge National Lab., TN (USA)). Aug 1979. Contract W-7405-ENG-26. 168p. P 08/MF A01.

An analytical evaluation of the Oak Ridge National Laboratory Garden Carrier No. 2 was made to demonstrate its compliance with the regulations governing off-site radioactive material shipping packages. The evaluation encompassed five primary categories: structural integrity, thermal resistance, radiation shielding, nuclear criticality safety, and quality assurance. The results of the evaluation show that the cask complies with the applicable regulations.

53541 (ORNL/ENG/TM—15) **Safety analysis report for packaging: the unirradiated fuel shipping container.** Evans, J.H.; Shipley, W.D.; Mouring, R.W. (Oak Ridge National Lab., TN (USA)). Sep 1979. Contract W-7405-ENG-26. 72p. P 04/MF A01.

The container was evaluated analytically to determine its compliance with the applicable regulations governing containers in which radioactive and fissile materials are transported, and the evaluation is the subject of this report. Computational and test procedures were used to determine the structural integrity and thermal behavior of the container relative to the general standards for normal conditions of transport and the standards for hypothetical accident conditions. Results of the evaluation demonstrate that the container is in compliance with the applicable regulations.

53542 (ORNL/TM—6471) **Chemical Technology Division Quality Assurance Program for radioactive material packagings.** Seagren, R.D.; Watson, C.D.; Box, W.D. (Oak Ridge National Lab., TN (USA)). Sep 1979. Contract W-7405-ENG-26. 57p. P 04/MF A01.

The report serves as a supplement to the Safety Analysis Reports for Packagings (ORNL-5406/R1, -5407/R1, -5408/R1, -5409/R1).

LASERS

53543 (COO—4223-7) **Investigation of concept of efficient short wavelength laser. Quarterly progress report, 1 November 1978—31 January 1979.** Krech, R.H.; Piper, L.G.; Pugh, E.R.; Taylor, R.L. (Physical Sciences, Inc., Woburn, MA (USA)). Mar 1979. Contract ES-77-C-02-4223. 23p. (PSI-TR—173). P 02/MF A01.

Quantitative analysis of data collected on the fluorescence emission (or lack thereof) from the uv photolysis of ClN_3 is presented. The purpose of this investigation is to develop an efficient short wavelength laser based on a class of endoergic molecules (azides) with characteristics applicable to a laser fusion driver. It is found that there is essentially no fluorescence emission at 664.7 nm. from ClN_3 upon flash photolysis. Possible explanations for this anomalous result are considered. Progress on the solid azide laser demonstration experiment is reported. A discussion of initial experiments to detect ClN fluorescence at 665 nm. and the supporting spectroscopy is given. (SPH)

53544 (UCRL—50025-79-2, pp 12-14) **Picosecond photodetector for 275-nm to 1-μm laser pulses.** 30 Jun 1979.

In Electronics Engineering Department quarterly report No. 2, 1979.

Using commercially available diode chips, photodetectors with a picosecond temporal response and a broad spectral response (from ultraviolet to infrared) have been fabricated. Improved photoresponse sensitivity is achieved by removing the anode gold contact that obscures the active region of the diode. Junction geometry is such that the depletion region is approximately perpendicular to the surface being illuminated, making the device especially useful for broad spectrum photodetection.

HEAT TRANSFER AND FLUID FLOW

REFER ALSO TO CITATION(S) 52442, 52444, 52445, 53246

MATERIALS TESTING

REFER ALSO TO CITATION(S) 52444, 53204, 53427

ELECTRONIC CIRCUITS AND DEVICES

REFER ALSO TO CITATION(S) 53528, 53582, 53864

53545 (CONF-790622—26) **Analysis of the multiphase inductor-converter bridge.** Ehsani, M.; Kustom, R.L.; Fuja, R.E. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 8p. P 02/MF A01.

From Pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

Analytical derivations are presented for inductor-converter bridge (ICB) circuits in which energy is transferred from a storage inductor to a load inductor with solid state bridges. These derivations provide complete analytical circuit solution in contrast to previously available numerical (non-analytical) procedures. The analysis is based on two parallel methods: (1) Fourier expansion of the inverter waveforms; and (2) a novel method based on the inherent waveforms of the ICB, labeled square functions. Our analytical values of power flow, inductor currents, and voltages compare favorably with the results of a three-phase ICB experiment at Argonne National Laboratory.

WASTE PROCESSING PLANTS AND EQUIPMENT

REFER ALSO TO CITATION(S) 53359, 53409

COMBUSTION SYSTEMS

REFER ALSO TO CITATION(S) 52421, 52498, 52527, 52799, 53143

53546 (COO—4916-1) **Development of a biomass energy system for drying corn. Progress report, July 1, 1978-June 30, 1979.** Buchele, W.F.; Claar, P.W. II; Marley, S.J. (Johns Hopkins Univ., Baltimore, MD (USA). Dept. of Environmental Engineering Science). Jun 1979. Contract EM-78-S-02-4916. 14p. P 02/MF A01.

The following research efforts have been carried out: evaluation of the design specifications and operation of the ISU-AE incinerator furnace; evaluation of existing furnace types for application to burning agriculatural residues; and design of a direct-fired furnace fueled by corn plant residues. The progress that has been made during the past year is summarized. Research has been carried out to provide the deisgn parameters for a new furnace prototype.

53547 Selection and operating experience of once through coil boilers (1000 t/d - 55 bar/430°C). Brady, J.P.; Gillis, A.W.; Smith, J. (Imperial Chemical Industries Ltd., Winnington, England). pp 95-101 of Steam at work: industrial and marine steam plant. New York, NY; Mechanical Engineering Publications Limited (1977).

From Conference on steam at work: industrial and marine steam plant; Manadon, Plymouth, UK (10 May 1977).

Wallescote Works, ICI Limited, operates on a total energy system with heat recovery. The latter is a major factor in determining boiler feed make-up treatment and thus the type of boiler which can be used. Once-through coil boilers were selected and installed in 1973, 1975, and 1976 as the boiler with the lowest capital and operating costs capable of producing turbine quality steam using the existing feedwater. Comparative installed cost with other types of boilers are given. The boiler and control system are described. Precautions taken against the tube failure are reviewed together with experience gained.

MARINE ENGINEERING

REFER ALSO TO CITATION(S) 53142

POLLUTION CONTROL EQUIPMENT

REFER ALSO TO CITATION(S) 53637, 53645, 53646

PARTICLE ACCELERATORS

DESIGN, DEVELOPMENT, AND OPERATION

REFER ALSO TO CITATION(S) 53846

53548 (ANL—78-66, pp 5-21) **Superconducting linac.** Bollinger, L.M.; Shepard, K.W.; Wangler, T.P. 1978.

In Physics Division annual review, 1 April 1977—31 March 1978.

This project has two goals: to design, build, and test a small superconducting linac to serve as an energy booster for heavy ions from an FN tandem electrostatic accelerator, and to investigate various aspects of superconducting rf technology. The main design features of the booster are described, a status report on various components (resonators, rf control system, linac control system, cryostats, buncher) is given, and plans for the near future are outlined. Investigations of superconducting-linac technology concern studies on materials and fabrication techniques, resonator diagnostic techniques, rf-phase control, beam dynamics computer programs, asymmetry in accelerating field, and surface-treatment techniques. The overall layout of the to-be-proposed ATLAS, the Argonne Tandem-Linac Accelerator System, is shown; the ATLAS would use superconducting technology to produce beams of 5 to 25 MeV/A. 6 figures. (RWR)

53549 (ANL—78-66, pp 97-111) **Accelerator operations.** 1978.

In Physics Division annual review, 1 April 1977—31 March 1978.

Operating experience for the tandem is briefly summarized, as are operating plans for the superconducting linac. These two devices are later to be coupled. The tandem was greatly improved by the installation of a new type of accelerator tube and by modernization of the vacuum system. Specific aspects of the upgrading discussed are the tandem injection system, high-energy and low-energy beam lines, and tandem terminal and terminal control. Other developmental activities involved the beam-bunching system and foil stripping. Operational experience with the dynamitron is reviewed, and university use of the two machines is tabulated. 1 figure. (RWR)

BEAM DYNAMICS, FIELD CALCULATIONS, AND ION OPTICS

53550 (INIS-mf—4820) **Foundations of superconducting magnetic system design. Superconducting systems for accelerators. Vol. 2.** (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow; Ministerstvo Ehlektropromyshlennosti SSSR, Moscow). 1977. 160p. (In Russian). (CONF-750950—P3). U 04/MF A01.

From Conference on technical applications of superconductivity; Alushta, USSR (16 Sep 1975).

Papers from this conference was processed as they were received on ATOMINDEX tapes for inclusion in the TIC data base. (RWR)

53551 (LBL—8382) **Stability of intense transported beams.** Laslett, L.J.; Smith, L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1979. Contract W-7405-ENG-48. 4p. (CONF-790327—111). P 02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

At the previous National Accelerator Conference, the transport of intense ion beams, with particular reference to Heavy Ion Fusion, was analyzed by finding matched solutions of the coupled envelope equations. This work established relations between lattice structure, beam dimensions and space-charge tune depression as a function of intensity. An investigation of the stability of the K-V distribution in transport by a periodic quadrupole system, a general-

ization of Gluckstern's analysis for a continuous solenoid is reported. The results are presented and compared with simulation computations for a particular case; the results provide a prediction of maximum transportable current without degradation of emittance due to instability.

53552 (ORNL/CSD/TM—53) **GOC: General Orbit Code.** Maddox, L.B.; McNeilly, G.S. (Oak Ridge National Lab., TN (USA)). Aug 1979. Contract W-7405-ENG-26. 122p. Dep. NTIS, PC E03/MF E03.

GOC (General Orbit Code) is a versatile program which will perform a variety of calculations relevant to isochronous cyclotron design studies. In addition to the usual calculations of interest (e.g., equilibrium and accelerated orbits, focusing frequencies, field isochronization, etc.), GOC has a number of options to calculate injections with a charge change. GOC provides both printed and plotted output, and will follow groups of particles to allow determination of finite-beam properties. An interactive PDP-10 program called GIP, which prepares input data for GOC, is available. GIP is a very easy and convenient way to prepare complicated input data for GOC. Enclosed with this report are several microfiche containing source listings of GOC and other related routines and the printed output from a multiple-option GOC run.

53553 (UCRL-Trans—1574) **Estimation of the possibilities of longitudinal stochastic cooling by means of a system with an inverse comb filter.** Parkhomchuk, V.V.; Pestrikov, D.V. Jun 1979. Translated from an unpublished Russian report, 1979. 9p. P 02/MF A01.

The analysis shows the feasibility of cooling a beam with spread $\Delta p/p/\text{sub } s/ \simeq 10^{-2}$ and particle number 2.5 10^7 in a time of the order of a few seconds. However, the complexity of such a system will obviously be comparable to an analogous system using electronic cooling.

53554 (LA-tr—79-18) **Calculation of quadripolar focusing of a linear accelerator and of beam adaptation in the presence of a space charge.** Bru, B. (European Organization for Nuclear Research, Geneva (Switzerland)). 1979. Translation of MPS/LIN/70-10, November 5, 1970. 42p. P 03/MF A01.

This study concerns the determination of the focusing structure of a proton linear accelerator (as well as the beam parameters adapted to this structure) in the presence of space charge forces. In the method used, the beam is likened to a uniformly charged ellipsoid, and the space charge forces are calculated as a function of its three dimensions. (GHT)

53555 (LA-tr—79-19) **Particle dynamics in an ion linear accelerator operating in double frequency regime.** Bomko, V.A.; Volkov, V.I.; Meleshkova, Yu.V.; Khizhnyak, N.A. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1979. Translation of KhFTI—77-40, 1977. 34p. P 03/MF A01.

The results of a series of studies of particle dynamics in an accelerator of the resonator type with drift tubes under simultaneous excitation of waves with a longitudinal electric field component on the axis of the cavity are given. The goal was to determine the optimum characteristics of these waves to maximize the monoenergetic character of the accelerated beam without deterioration of its other parameters. (GHT)

53556 (LA-tr—79-33) **Effects of the space charge in proton linear accelerators.** Prome, M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). 1979. Translation of CEA-N—1457, 1971. 142p. P 02/MF A01.

Thesis. Submitted to Paris Univ., Orsay, France.

Equations for dynamics without space charge are presented. The dynamic equations are reviewed and new equations for particle dynamics are presented. The two phenomena limiting accelerated current in a proton linear accelerator are reviewed. Beam loading, which causes a decrease in field as the beam is accelerated, can be corrected by increasing power to the resonant cavity while the beam is passing through. Space charge, under the effect of Coulomb repulsion causes the beam to increase in size, to diverge, and to become incoherent. The phenomenon of growth in the radial emittance is demonstrated, the conditions under which it occurs are determined, and the extent of this growth is determined as a function of the current. Methods for calculating the space charge are presented. (GHT)

AUXILIARIES AND COMPONENTS

REFER ALSO TO CITATION(S) 53550

53557 (BNL—26412) **Accelerators and storage ring.** Lee, Y.Y. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 38p. (CONF-790744—1). P 03/MF A01.

From Workshop on high energy experiments in Korea; Seoul, Republic of Korea (23 Jul 1979).

The high energy accelerators are proven to be a very useful tool not only for high energy physics, but also for the whole field of physics as well as other scientific fields. Possible accelerators both for electron or positron and proton accelerator schemes are discussed, and rudimentary theory behind the accelerators and the technology required for the construction of the accelerator are described. The advantages and disadvantages of the accelerators are presented. The choice of the accelerator (electron-positron or proton, energy, intensity) is of course made by physics priority, technical availability, usefulness to other fields and economic considerations.

53558 (LA—7930-C) **Report on Kaon Factory Working Seminar, Spring 1979.** Silbar, R.R.; Bowman, J.D. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 13p. P 02/MF A01.

The motivations, discussions, and preliminary conclusions of the LASL Kaon Factory Working Seminar, which met 15 times in the Spring of 1979 are reported. It is technically feasible, but expensive, to build a kaon factory using LAMPF as an injector. Taking advantage of the increased beam intensity, better secondary beam lines can then be built. The physics justification for a kaon factory requires further study, however. A proposed program is outlined for gradually increasing LASL participation in kaon and antiproton physics.

EXPERIMENTAL FACILITIES AND EQUIPMENT

53559 (LA—7734-PR) **Collective ion acceleration. Progress report, October 1977—September 1978.** Faehl, R.J.; Godfrey, B.B. Shanahan, W.R. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 151p. P 08/MF A01.

Numerical and analytic studies of collective ion acceleration in intense relativistic electron beams are presented. Investigation of autoresonant acceleration has shown that radial beam inhomogeneities distort the slow cyclotron wave into a surface-localized mode. Variation of linear wave fields in inhomogeneous magnetic fields is strongly affected by this. Numerical studies of self-consistent cyclotron waves show the persistence of linear characteristics even at large amplitudes. Propagation of large amplitude waves has been observed over moderate distances in simulations without significant attenuation or nonlinear disruption. Ion acceleration in virtual cathodes has also been studied. Insights into both formation and late time dynamics have been gained. Increased virtual cathode understanding is being pursued toward defining optimal configurations. Future plans are outlined.

53560 (LA—7915-MS) **LAMPF 805-MHz accelerator structure tuning and its relation to fabrication and installation.** Swain, G.R. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 127p. P 07/MF A01.

In the course of construction of the 805-MHz linac, it was necessary to set 10,000 resonant cavities to precise frequencies and to check, and in some cases, to adjust the field distribution along the beam axis of the 104 rf tanks composing the linac. Since this was the first proton linac of the side-coupled type ever built, it was necessary to develop new techniques and instrumentation for structure tuning. An outline of the fabrication and installation process is given, showing how the tuning operations were interwoven with the fabrication steps and indicating the relation of tuning to other installation and check-out activities. The steps of the tuning procedure are then examined in detail. Tools for tuning by dinging, nose-stretching, and septum bending are described. Techniques for frequency measurements and for beadpull measurements of field distribution are discussed. The section on field distribution measurement includes results of research on measurement procedure and theory and observations confirming the low-power stability of field distributions for a three-year period. Selected results from the theory of chains of coupled resonators are given. Coupled resonator model parameters and various measured parameters for the 805-MHz linac are tabulated.

53561 (LBL—8899) **Prospects for high energy heavy ion accelerators.** Leemann, C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1979. Contract W-7405-ENG-48. 9p. (CONF-790327—110). P 02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

The acceleration of heavy ions to relativistic energies ($T \geqq 1$ GeV/amu) at the beam intensities required for fundamental research falls clearly in the domain of synchrotons. Up to date, such beams have been obtained from machines originally designed as proton acccelerators by means of modified RF-programs, improved vacuum and, most importantly, altered or entirely new injector systems. Similarly, for the future, substantial changes in synchrotron design itself are not foreseen, but rather the judicious application and development of presently known principles and technologies and a choice of parameters optimized with respect to the peculiarities of heavy ions. The low charge to mass ratio, q/A, of very heavy ions

demands that superconducting magnets be considered in the interest of the highest energies for a given machine size. Injector brightness will continue to be of highest importance, and although space charge effects such as tune shifts will be increased by a factor q^2/A compared with protons, advances in linac current and brightness, rather than substantially higher energies are required to best utilize a given synchrotron acceptance. However, high yeilds of fully stripped, very heavy ions demand energies of a few hundred MeV/amu, thus indicating the need for a booster synchrotron, although for entirely different reasons than in proton facilities. Finally, should we consider colliding beams, the high charge of heavy ions will impose severe current limitations and put high demands on system design with regard to such quantities as e.g., wall impedances or the ion induced gas desorption rate, and advanced concepts such as low β insertions with suppressed dispersion and very small crossing angles will be essential to the achievement of useful luminosities.

53562 (PUB—5025) **VENUS project: accelerator and storage ring for relativistic heavy ion physics.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1979. Contract W-7405-ENG-48. 55p. P 04/MF A01.

The VENUS accelerator project, presently under study at LBL, is conceived as a research facility to serve the United States' heavy ion physics program in the 1980's and beyond. A wide range of experimental goals can be satisfied with the proposed machine. The VENUS system will consist of two superconducting accelerator/storage rings, which are used to supply ion beams through uranium with energies from 40 MeV/A to 20 GeV/A for fixed target operation, and beams of the same or different ions from 2 on 2 to 20 on 20 GeV/A for colliding beam operation. The physics potential of VENUS will extend from the low energy region to high energies well beyond the range of existing facilities such as the Bevalac. The high center of mass energies available with colliding beams wll open up new fields of research - into unexplored territory of high density nuclei and quark matter. VENUS will be located on the Bevalac site, using the SuperHILAC as injector. There will be extensive re-use of existing buildings and support facilities. The anticipated schedule projects construction authorization in 1983 and completion in 1987.

53563 (SLAC-PUB—2274) **Next generation of electron-positron colliding beam machines.** Richter, B. (Stanford Univ., CA (USA)). Mar 1979. Contract EY-76-C-03-0515. 23p. (CONF-7804128—1). P 02/MF A01.

From Washington meeting of the American Physical Society; Novosibirsk, USSR (25 Apr 1978).

The contribution of electron-positron colliding beam experiments to high-energy physics in the 1970's has been prodigious. From the research done with the two highest-energy e^+e^- machines of the present generation of these devices, have come such things as the discovery and illumination of the properties of the psi family, charmed particles, a new heavy lepton, non-ambigious evidence for hadronic jets, etc. The rapid pace of new developments in physics from such machines comes about for two reasons. First, the electron-positron annihilation process at present energies is particularly simple and well understood, making the problem of determining the quantum numbers and properties of new particles particularly simple. Second, in electron-positron annihilation all final states are on a relatively equal footing, and small production cross sections are compensated for by a lack of confusing background. For example, the rate of production of charmed particles at the SPEAR storage ring at SLAC and the DORIS storage ring at DESY is 3 or 4 orders of magnitude less than the rate of production at FNAL and the SPS. Yet these particles were first found at the storage rings where the background cross sections are comparable to the signal cross section, and have not yet been observed directly by their hadronic decays at the proton machines where the background cross sections are 4 orders of magnitude larger than the signal cross sections. The machines PEP at SLAC and PETRA at DESY will soon be operating at 35 to 40 GeV cm to explore new regions of energy. Studies of electron-positron annihilation at much higher energies than presently planned have a great deal to teach, not only about particle structure and dynamics, but also about the nature of the weak interaction. Some of the physics which can be done with such machines is discussed with a view toward getting an idea of the minimum required energy for the new generation of colliding beam devices.

53564 (UCRL—15050) **Design study for ATA vacuum system aperture.** Hibbs, S. (Avco-Everett Research Lab., Inc., Everett, MA (USA)). 26 Jul 1979. Contract W-7405-ENG-48. 24p. P 02/MF A01.

A design study for a vacuum system aperture for the Advanced Test Accelerator is described. A combination suction/axial aerowindow concept is recommended. (GHT)

53565 (UCRL—15051) **Conceptual design and performance estimates for a supersonic aerodynamic window for the ATA vacuum system aperature. Final report.** Erdos, J.I. (General Applied Science Labs., Inc., Westbury, NY (USA)). Jun 1979. Contract W-7405-ENG-48. 37p. P 03/MF A01.

A family of supersonic aerodynamic window devices for the ATA aperture have been examined. These included transverse supersonic jet flows of the compression window type, the expansion window type, and an extended expansion window type, as well as an axial supersonic ejector type window. The pure compression type window was rejected because it would require a nozzle exit Mach number exceeding 8.5 to support an attached shock wave. The pure expansion window is optimized at an exit Mach number of unity, but requires 4 times the mass flow rate of the pure compression window, and would probably be unstable at M/sub e/ < 1.5 to 2.0. The extended expansion window was found to require mass flows of the same order as the pure compression window, but is optimized at M/sub e/ ≅ 3. The supersonic ejector would require two stages each having an exit Mach number exceeding 6 to achieve mass flow rates competitive with the extended expansion window. In addition, it appears very doubtful that an efficient ejector could be designed within the overall length limitation. Ejector designs which might meet the length limitation will probably require substantially (2 to 3 times) higher mass flow rates than the extended expansion window. Therefore, the supersonic transverse extended-expansion window (STEW) is considered the preferred design. At an exit Mach number of 3 it would require about 0.16 lb/sec of air at a supply pressure of 540 psia. Continuous operation for periods up to 1 hour could be achieved with a farm of 80 compressed air bottles, for example. However, the optimized design would have a throat height of 0.5mm. Therefore pragmatic considerations related to fabrication may dictate a non-optimal design. Reducing the exit Mach number to 2.5, for example, would increase the throat height to 1.0mm with a small (15%) penalty in mass flow rate.

53566 (LA-tr—79-21) **Saturn II alignment principles.** Poullain, M. (CEA, 75 - Paris (France)). 1979. Translation of GERMA 75.06/GEO-01, January 14, 1975. 12p. Dep. NTIS, PC A02/MF A01.

The principles used for the installation, alignment, and alignment monitoring of the Saturn II accelerator are described. (GHT)

STORAGE RINGS

53567 (SLAC-PUB—2272) **rf reference line for PEP.** Schwarz, H.D.; Weaver, J.N. (Stanford Linear Accelerator Center, CA (USA)). Mar 1979. Contract EY-76-C-03-0515. 3p. (CONF-790327—107; PEP-NOTE—284). P 02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

A rf phase reference line in 6 segments around the 2200 meter circumference PEP storage ring is described. Each segment of the reference line is phase stabilized by its own independent feedback system, which uses an amplitude modulated reflection from the end of each line. The modulation is kept small and decoupled from the next segment to avoid crosstalk and significant modulation of the rf drive signal. An error evaluation of the system is made. The technical implementation and prototype performance are described. Prototype tests indicate that the phase error around the ring can be held below 1 degree with this relatively simple system.

INSTRUMENTATION

RADIATION INSTRUMENTATION

GENERAL DETECTORS AND MONITORS

REFER ALSO TO CITATION(S) 52655, 52714, 53209

53568 (LA-UR—79-1857) **Measurement system for high enriched spent fuel assemblies and waste solids.** Eccleston, G.W.; Menlove, H.O.; Echo, M.W. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 13p. (CONF-790707—19). P 02/MF A01.

From 20. annual meeting of the Institute of Nuclear Materials Management; Albuquerque, NM, USA (16 Jul 1979).

A nondestructive neutron interrogation system, being developed to assay the ^{235}U content in bulk waste solids and high enriched spent fuel assemblies, is described. The instrument will be used for both nuclear materials accountability and criticality control by the facility operator. A range of fissile contents varies from 0 to 400 g in the waste and from about 8 to 12 kg in the spent fuel elements. Measurements must be obtained in the presence of large neutron (1.2×10^7 n/s) and gamma (50,000 R/h) backgrounds. The system employs fast-neutron interrogation of the sample using a 5 mg ^{252}Cf source combined with delayed neutron counting after the source is moved to storage. Preliminary monte carlo calculations indicate measurement precisions of better than +-5% (2σ) are obtainable for waste loadings in excess of 200 g ^{235}U.

RADIATION DOSEMETERS

REFER ALSO TO CITATION(S) 53720

RADIOMETRIC INSTRUMENTS

53569 (SAND—79-8030) **RET16K interface.** Akins, J. (Sandia Labs., Albuquerque, NM (USA)). Jul 1979. Contract EY-76-C-04-0789. 78p. P 05/MF A01.

The RET16K interface subsystem provides data control and real-time data storage for the RC100 Reticon system. The RC100 Reticon isused to x-ray scan pyrotechnic microvalves during actual operation. The RET16K digitizes the video output, provides a byte per diode, packs two bytes per word, and sorts 32768 8-bit bytes per test.

RADIATION EFFECTS ON INSTRUMENT COMPONENTS, INSTRUMENTS, OR ELECTRONIC SYSTEMS

53570 (AD-A—062083) **Grounding and shielding requirements for the radiation and EMP environments of an underground nuclear test. Final report, November 1976-November 1977.** Scott, L.; Parkinson, R. (Science Applications, Inc., Colorado Springs, CO (USA)). 17 Mar 1978. Contract DNA001-77-C-0073. 88p. Y A05/MF A01.

This report presents the pertinent experiences or lessons learned from implementing an integral grounding and shielding program (GSP) for the Hybla Gold event, an underground nuclear test at NTS. Part I shows that multi-point grounding and multiple topological shields for protecting the data channels proved to be very successful in providing noise-free data. Proper management controls are identified to ensure the uniform treatment of gauge cables, which is required for the success of The GSP. The details of EM field generation, coupling, and propagation in the Hybla Gold experimental plant is presented in Part II. The conclusions drawn from the environmental predictions logically result in the actions described in Part I. This combined report enables an experimenter to plan and execute such tests with more understanding of the noise sources and how to deal with them successfully.

53571 (N—79-14273) **Voyager electronic parts radiation program. Volume 2: Test requirements and procedures.** Stanley, A.G.; Martin, K.E.; Price, W.E. (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Dec 1978. Contract NAS7-100. 98p. Y A05/MF A01.

Documents are presented outlining the conditions and requirements of the test program. The Appendixes are as follows: appendix A -- Electron Simulation Radiation Test Specification for Voyager Electronic Parts and Devices, appendix B -- Electronic Piece-Part Testing Program for Voyager, appendix C -- Test Procedure for Radiation Screening of Voyager Piece Parts, appendix D -- Boeing In Situ Test Fixture, and appendix E -- Irradiate - Anneal (IRAN) Screening Documents.

MISCELLANEOUS INSTRUMENTS

REFER ALSO TO CITATION(S) 52461, 52483, 52531, 53248, 53544, 53582

53572 (CONF-790839—2) **Quantitative x-ray microanalysis in an AEM: instrumental considerations and applications to materials science.** Zaluzec, N.J. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 68p. P 04/MF A01.

From 37. annual Electron Microscopy Society of American meeting; San Antonio, TX, USA (13 Aug 1979).

There are a wide variety of instrumental problems which are present to some degree in all AEM instruments. The nature and magnitude of these artifacts can in some instances preclude the simple quantitative interpretation of the recorded x-ray emission spectrum using a thin-film electron excitation model; however, by judicious modifications to the instrument these complications can be effectively eliminated. The specific operating conditions of the microscope necessarily vary from one analysis to another depending on the type of specimen and experiment being performed. In general, however, the overall performance of the AEM system during x-ray analysis is optimized using the highest attainable incident electron energy; selecting the maximum probe diameter and probe current consistent with experimental limitations; and positioning the x-ray detector in a geometry such that it records information from the electron entrance surface of the specimen.

53573 (CONF-790839—3) **Dependence of secondary electron image contrast of periodic objects upon probe diameter.** Bentley, J.; Carpenter, R.W. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 2p. P 02/MF A01.

From 37. annual Electron Microscopy Society of American meeting; San Antonio, TX, USA (13 Aug 1979).

The effect of probe diameter upon secondary electron image contrast of periodic objects has been studied systematically. Interest in the topic arose following the observation of out-of-focus SEM images of conventional mesh support grids, where the basic periodicity was visible even with probe diameters many times the periodic spacing. The instrument used was a JEM-120CX/ASID operated in the SEM mode at low magnification with the objective lens off and other lenses in the free-control mode. The probe diameter at the specimen position was controlled by the continuously variable second condenser lens current. The first intermediate lens was focussed at the specimen position, thus allowing a determination of the probe diameter from the magnified shadow image, which could be photographed using the conventional TEM camera. The specimen used was a copper bar grid with spacings $\simeq 125\ \mu m$.

53574 (SAND—78-2263) **SETUP: an auxiliary program for establishing measurement parameters for quantitative microprobe analyses.** Chambers, W.F. (Sandia Labs., Albuquerque, NM (USA)). Jul 1979. Contract EY-76-C-04-0789. 22p. P 02/MF A01.

SETUP is part of a quantitative analysis package designed to operate under the SANDIA TASK '78 control program for electron microprobes which are automated with Tracor Northern electronics. SETUP is a Flextran routine that resides in the auxiliary program section of TASK '78 and is used in conjunction with the QUANT schedule for setting crystal spectrometer, energy dispersive, beam and stage conditions in preparation for a quantitative analysis.

53575 (SAND—79-0797) **COMUX: a combinatorial multiplexer for diagnostic scanning of multiterminal thermocouple and microvolt-level circuits.** Kimball, K.B.; Denney, C.A. (Sandia Labs., Albuquerque, NM (USA)). Aug 1979. Contract EY-76-C-04-0789. 63p. P 04/MF A01.

The combinatorial multiplexer (COMUX) is a group scanner combined with a matrix switch that connects various combinations of signal lines, shields, and reference points to a multifunction meter for measurement. All signal lines are switched with low-thermal electromotive force (emf) relays to allow scanning of microvolt level signals. The COMUX may be operated manually or under computer control via the IEEE 488 Standard Digital Interface for Programmable Instrumentation.

53576 (SLAC-TN—79-6) **Instruction manual for NIM bin test module II.** Seefred, R.H.; Farwell, D. (Stanford Linear Accelerator Center, CA (USA)). Jun 1979. Contract EY-76-C-03-0515. 10p. P 02/MF A01.

A test module was constructed for insertion into a standard NIM crate to test all voltage and load conditions of all manufactured NIM power supplies. Three basic tests are conducted: voltage, current limiting characteristics, and the ability of the power supply to resist oscillations. The unit is packaged in a NIM No. 4 module and can be read out through a DVM output or with meters located on the front panel.

53577 (UCRL—50025-79-2, pp 18-24) **Development of a miniature, rapid-response carbon dioxide sensor.** 30 Jun 1979.

In Electronics Engineering Department quarterly report No. 2, 1979.

The Laboratory is developing a miniature carbon dioxide sensor that will accurately detect fluctuations in ambient CO_2 concentrations of 0.1 ppM for the study of plant physiology. This sensor has a full-scale response of 10 Hz and an input power requirement of 3 W. The sensor head, weighing less than 0.5 kg, can be held in the palm of the hand. Insensitive to vibration or random acceleration, the sensor is nonthermostated and will operate in noncondensing environments from -20 to $+40°C$.

53578 (UCRL—82872) **Temperature measurements on a rotating, water-cooled substrate at high voltage.** Arluck, J.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Jul 1979. Contract W-7405-ENG-48. 10p. P 02/MF A01.

The temperature-measurement system currently in use is an R and D measurement system capable of recording data from as many as nine thermocouples on a rotary, water-cooled substrate at high voltage. This system could easily be adapted to temperature measurements during ion plating, ion milling, sputtering, or other processes using high voltage and water cooling.

53579 **Performance of strain-gauge installations in pressurized water at elevated temperatures.** Engbaeck, P.; Petersen, H.; Andersen, S.I. pp 565-571 of 6. Internationale Konferenz 'Experimentelle Spannungsanalyse'. Duesseldorf, Germany, F.R.; VDI-Verl. (1978).

Reliable bonding and moisture protection techniques for strain gauges are essential for the quality of the results obtained from use of the gauge installations. Several procedures and products are commercially available for different applications, but often installation procedures can be difficult or costly, and the required environment difficult to provide. This is the case when applying strain

gauge measurements during the proof testing of nuclear reactor pressure vessels, where a great number of gauges have to be installed in a very short space of time in the workshop of the vessel manufacturer, and the measurements are performed with the installation in pressurized water at an elevated temperature (230 bar, 50°C), which is one of the more difficult environments for strain gauges. This paper presents the results of an investigation of the fitness and the stability of gauge installations for the above applications. Commercially available products were used in different combinations, and the installations were subjected to simulated environmental conditions and to some exaggerated temperatures in order to determine some kind of a safety margin.

WELL LOGGING INSTRUMENTATION

REFER ALSO TO CITATION(S) 53098, 53763

EXPLOSIONS AND EXPLOSIVES

CHEMICAL

53580 (LA—7572) **Carbon-13 NMR analyses of TATB and related compounds in sulfuric acid.** Harris, B.W. (Los Alamos Scientific Lab., NM (USA)). Apr 1979. Contract W-7405-ENG-36. 19p. P 02/MF A01.

The insensitive explosive 1,3,5-triamino-2,4,6-trinitrobenzene (TATB), which is used in explosive systems, is insoluble in most solvents. Thus, a suitable assay has not been developed for it. Strong acids such as trifluoromethane sulfonic acid and sulfuric acid dissolve TATB, but very little was known about the chemical nature of these systems. This study determined ^{13}CNMR data on substituted nitrobenzene and substituted nitroaniline derivatives that are starting materials for and intermediate products from the synthesis of TATB. These data were correlated with those from the TATB-strong acid system, clarifying the nuclear structure of TATB in these solvents. TATB became protonated at C_4 and exists as an equilibrium mixture of the amino and imino forms in sulfuric acid, with the imino form as the predominate one. These results can be used to develop an assay for TATB. Special attention was given to the solvent effects, substituent effects, and protonation effects on the ^{13}CNMR spectra of the compounds studied. Nitrogen-15 labeled compounds were used where the carbon-13 absorption was questionable. Coupling constants for $^{13}C^{15}N$ and $^{13}C^{1}H$ were determined.

53581 (SAND—79-8223) **X-ray photoemission studies of B/$CaCrO_4$ pyrotechnics.** Mills, B.E. (Sandia Labs., Albuquerque, NM (USA)). Jul 1979. Contract EY-76-C-04-0789. 35p. P 03/MF A01.

The surfaces of 20/80 weight percent B/$CaCrO_4$ pyrotechnic mixtures having different firing energies were studied with x-ray photoelectron spectroscopy (XPS or ESCA). Some oxidation of boron and reduction of Cr (VI) was seen, but the most striking observation was the apparent variation in surface boron concentration. A correlation between the energy required to initiate 99.9% of a representative number of devices made from a powder blend and the surface composition of that powder was found. The sample with the lowest firing energy had more than twice as much boron on the surface as that with the highest. Effects of solvents on the unmixed powders are also reported, and a suggestion is given for an improved testing procedure.

53582 (UCRL—50025-79-2, pp 5-11) **Two electro-optical systems for explosive diagnostics and equation-of-state research.** 30 Jun 1979.

In Electronics Engineering Department quarterly report No. 2, 1979.

The Fabry-Perot system was developed, primarily at LLL, to measure directly the speed of a metallic surface driven by high explosives or by an electric gun (an exploding bridge foil). It is based on laser interferometry, which measures the Doppler shift in the frequency of the laser light reflected from the moving body. The simplicity of its components, operation, and data reduction gives this velocimeter significant advantages over other systems. The main components are a high-speed electro-optic streak camera, an argon-ion laser, and a Fabry-Perot interferometer. The streak camera can also measure the velocity of shockwaves through metals under high-pressure impact.

NUCLEAR

REFER ALSO TO CITATION(S) 53570

53583 (UCRL—50025-79-2, pp 1-4) **Modular design improves diagnostic system for nuclear tests.** 30 Jun 1979.

In Electronics Engineering Department quarterly report No. 2, 1979.

Electronic systems used to collect data from nuclear tests are subject to severe conditions - high levels of shock, vibration, and electrical noise. A mobile data-gathering system, the hybrid prompt diagnostic system, that functions reliably in the test environment has been developed. Its modular design minimizes data loss in the event of any system component failure and adapts quickly to various test requirements. Using a combination of analog and digital data acquisition units, the system can accommodate high-speed signals and still provide easily processed digital data.

WEAPONRY

REFER ALSO TO CITATION(S) 53722

53584 (AD-A—062366) **Conceptual design of a new damage assessment capability. Final report, 12 July 1977-31 March 1978.** Galiano, R.J.; Pugh, G.E. (Decision-Science Applications, Inc., Arlington, VA (USA)). Mar 1978. Contract DNA001-77-C-0307. 73p. Y A04/MF A01.

A new damage assessment capability is described. Statistical sampling techniques permit an advance in the state of the art of damage assessment beyond deterministic estimates of the outcomes of nuclear attacks. Now, uncertainties due to objectives, planning factors, environmental conditions, target and weapons effects can be addressed. Means, variances, and full distributions can be obtained to describe such factors as wind variability, uncertain reliability, penetration probability, probability of destruction before launch, etc., uncertainty in height of burst, population protection factors, and so on. All or any of these may be accommodated in a single fun, since sampling over the uncertainty distributions, sampling over national wind patterns, sampling AGZs from other attack descriptions, and applying standard effects calculations to a set of population samples, is the basis of a modular calculation. With standard damage assessment systems, any attempt to cover such a range of variation would imply an explosive combinatorial growth in computation time. (Author)

ENVIRONMENTAL SCIENCES, ATMOSPHERIC

BASIC STUDIES

REFER ALSO TO CITATION(S) 53596, 53603, 53749

53585 (CONF-771114—) **Energy and environmental stress in aquatic systems. DOE symposium series 48.** Thorp, J.H.; Gibbons, J.W. (eds.). (Savannah River Ecology Lab., Aiken, SC (USA); Georgia Univ., Athens (USA). Inst. of Ecology). Dec 1978. 873p. Z E08/MF E08.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

This symposium, Energy and Environmental Stress in Aquatic Systems, served as a forum for discussions of the environmental effects of alternative sources of energy. This exchange of information promotes a proper perspective in which to make critical judgments affecting a country's energy and environmental policies. The symposium was ideal for comparing effects of various stressors and for enabling researchers in one discipline to become acquainted with those in another area. Individual entries were made for the separate papers.

53586 (CONF-771114—, pp 1-18) **Modeling environmental stress.** Ulanowicz, R.E. (Univ. of Maryland, Solomons). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

The word stress when applied to ecosystems is ambiguous. Stress may be low-level, with accompanying near-linear strain, or it may be of finite magnitude, with nonlinear response and possible disintegration of the system. Since there are practically no widely accepted definitions of ecosystem strain, classification of models of stressed systems is tenuous. Despite appearances, most ecosystem models seem to fall into the low-level linear response category. Although they sometimes simulate systems behavior well, they do not provide necessary and sufficient information about sudden structural changes nor structure after transition. Dynamic models of finite-amplitude response to stress are rare because of analytical difficulties. Some idea as to future transition states can be obtained by regarding the behavior of unperturbed functions under limiting strain conditions. Preliminary work shows that, since community

variables do respond in a coherent manner to stress, macroscopic analyses of stressed ecosystems offer possible alternatives to compartmental models.

53587 (CONF-771114—, pp 62-101) **Stress and ecosystems.** Lugo, A.E. (Univ. of Florida, Gainesville). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

The literature dealing with issues of stress as it affects ecosystems is reviewed. Definitions of stress are discussed. Models and literature examples are presented to illustrate the push—pull (positive—negative) effects of most stressors and to suggest that the point of attack and the type of stressor determine the rate of response of the ecosystem. Stressors with high-quality energies (highly concentrated energy sources) that divert low-quality energy flows in a system appear to have a greater impact than stressors with low-quality energy (diluted energy sources) that impact high-quality energy flows. It is suggested that ecosystem complexity (including species diversity, physiognomy, three dimensional organization, etc.) is a function of the balance between energies that contribute to growth and organization and those that contribute to disorder. The classification of environments by their energy signatures (the sum of all incoming energy flows into a system and the pattern of their delivery expressed on equal energy-quality basis) is presented as the best way to arrange and analyze ecosystems hierarchically according to their capacity to develop complexity and to tolerate stress. The patterns of ecosystem response to stressors, including positive, steady-state, and declining responses and possible extinction, are discussed. It is argued that, to solve the problems of ecosystem management and the issues of environmental impact, studies and analyses must be done at the level of the ecosystem; and care should be taken to quantify both the stressor and the stress with units of comparable energy quality.

53588 (SAND—79-7041) **Meteorological data quarterly report WIPP site: Eddy County, New Mexico autumn quarter, September—November 1976.** Pocalujka, L.P.; Babij, E.; Church, H.W. (Sandia Labs., Albuquerque, NM (USA)). Jun 1979. Contract EY-76-C-04-0789. 120p. P 06/MF A01.

The WIPP meteorological, air quality, and radiological measurements program was implemented to support the environmental effort for the evaluations of the site selection suitability. This data report is the second of a series of seasonal quarterly data summaries to be issued for the southeastern New Mexico site.

53589 (UCID—18118) **Past climate reconstruction: a tool for assessing site suitability.** Potter, G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Jun 1978. Contract W-7405-ENG-48. 26p. P 03/MF A01.

Reconstructing past climatic variations can lead to a better understanding of possible future precipitation and groundwater recharge patterns. Work so far has led to several new insights into past climate variability and will provide input into the hydrologic modeling effort in progress for the Waste Management Program. Short-term reconstructions (0 to 350 y) suggest that the basin and range of the southwestern United States have the driest, least variable precipitation record. The Pacific Northwest shows higher variability and several trends lasting for more then 25 y. The Southern High Plains have even more variability, but the upper Midwest and Southwest vary most and have the highest precipitation amounts. Pollen and lake level data from the literature suggest that the Southwest was wetter during at least part of the last glacial maximum than it is today.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 52506, 52512, 52532, 52533, 53272, 53361, 53649, 53653, 53656, 53732, 53733, 53746

53590 (BNL—51002, pp 204-211) **Passive dosimeters for gases.** Palmes, E.D. (New York Univ. Medical Center, NY). Mar 1979.

From Symposium on assessing the industrial hygiene monitoring needs for the coal conversion and oil shale industries; Upton, NY, USA (5 Nov 1978).

The passive sampler is designed primarily to measure time weighted average exposures to gases for relatively long periods. Principles of operation of two types of passive samplers, diffusion and permeation, are discussed. (JGB)

53591 (BNL—51002, pp 223-232) **Pocket-sized personal air contaminant monitor.** Jerman, J.H.; Terry, S.C. (Stanford Univ., CA). Mar 1979.

From Symposium on assessing the industrial hygiene monitoring needs for the coal conversion and oil shale industries; Upton, NY, USA (5 Nov 1978).

A pocket-sized personal air contaminant analyzer is being developed to monitor a worker's exposure to toxic gases. The heart of this instrument is a miniaturized gas chromatograph, complete with carrier gas supply, pressure regulator, sample pump, and computer system. The instrument will be capable of automatically sampling the air at one minute intervals during an 8-hour shift, measuring the concentrations of up to 10 different gases, calculating and storing the average and peak concentrations of those gases, and sounding an alarm if potentially dangerous environmental conditions are detected. The miniature size of the package is due mainly to the use of integrated circuit processing techniques utilized in the fabrication of the major components of the chromatograph. This instrument, which is currently in the early prototype development phase, will allow the on-site monitoring of a mobile worker's exposure to multiple gaseous contaminant, which should have a significant impact on the field of industrial hygiene.

53592 (BNL—51002, pp 233-251) **Recent advances: solid state gas detection. Recent advances in thin solid films for solid state gas detection.** Leary, D.J.; Jordan, A.G. (Carnegie-Mellon Univ., Pittsburgh, PA). Mar 1979.

From Symposium on assessing the industrial hygiene monitoring needs for the coal conversion and oil shale industries; Upton, NY, USA (5 Nov 1978).

Several materials systems have shown promise as thin films for solid state gas detection when incorporated in integrated devices using standard planar processing techniques. Among the several active areas of pursuit, impressive recent advanced in thin film metal—oxide semiconductors, metals, and certain organic materials suggest a bright future for the development of highly intergradable solid state gas sensing devices. Recent developments in thin film metal—oxide semiconductors (ZnO) sensitive to CO and O_2, hydrogen and H_2S sensitive metal-gate MOS structures, and an organic thin film (phthalocyamine) sensitive to NO_2 are discussed.

53593 (BNL—51002, pp 252-262) **Portable gas detection: enhancement of semiconductor sensor capabilities by microcomputer control and signal processing.** Tuma, D.T.; Clifford, P.K. (Carnegie-Mellon Univ., Pittsburgh, PA). Mar 1979.

From Symposium on assessing the industrial hygiene monitoring needs for the coal conversion and oil shale industries; Upton, NY, USA (5 Nov 1978).

In research on the eventual development of a portable pollution monitor, a microcomputer-based data acquisition and analysis system was designed and constructed. To determine the necessary functional attributes of the system, a detector that typifies the state-of-the art in solid state gas detection, the Taguchi Gas Sensor (TGS) was studied. It was found that, at constant temperature in an oxygen rich ambient, the TGS resistance, R, varies with reducing gas concentration [C] as $R \sim K[C]^{-}$/sup β/, where K is a sensitivity coefficient peculiar to the reducing gas and the operating temperature, and β is a power law exponent. It seems possible that the dependence of the sensitivity constants K for various gases on detector temperature can be utilized to enhance the TGS selectivity in gas detection. The major complication to this scheme would be the long stabilization times involved when temperature is changed. Nevertheless, a synergistic combination of semiconductor sensors and microcomputer-based signal processing is expected to help overcome the most significant limitation of present sensors: their lack of selectivity. (JGB)

53594 (BNL—51002, pp 289-300) **Portable optical particle counters.** Marple, V.A. (Univ. of Minnesota, Minneapolis). Mar 1979.

From Symposium on assessing the industrial hygiene monitoring needs for the coal conversion and oil shale industries; Upton, NY, USA (5 Nov 1978).

The feasibility of using optical particle counters (OPCs) to measure dust size distributions and concentrations that may be found in mining operations. It is concluded that OPCs can be a useful tool in determining the size distribution and concentration of dust aerosols. Two systems have been built and are currently being used for studying these types of dust. It has also been shown that by using inertial impactors for calibration, it is possible to obtain a calibration of the OPC based upon the aerodynamic diameter of the particles, which is an important parameter in determining the quantity of respirable dust. Although the feasibility study of using the laser diode as a light in an OPC is currently in progress, it appears as though this light source may be an alternative to the incandescent bulb. Since the laser diode is very small, and the photo diode sensor is also small, it should be possible to make the entire optical tube, including the light source, optics, and detector, into a package small enough to be used as a personal sampler. Considerable electronics are also required for an OPC. However, with the miniaturization of electronic circuits, they should also be small enough to be compatible with a personal sampler. In addition, the electronics and laser diode require little power and should be compatible with the type of power that is currently used by personal samplers. (JGB)

53595 (COO—2874-50) **Survey of statistical techniques used in validation studies of air pollution prediction models.** Bornstein, R.D

Anderson, S.F. (San Jose State Univ., CA (USA). Dept. of Meteorology). Mar 1979. Contract EY-76-S-02-2874. 49p. P 03/MF A01.

Statistical techniques used by meteorologists to validate predictions made by air pollution models are surveyed. Techniques are divided into the following three groups: graphical, tabular, and summary statistics. Some of the practical problems associated with verification are also discussed. Characteristics desired in any validation program are listed and a suggested combination of techniques that possesses many of these characteristics is presented.

53596 (EPRI-EA—1074) **Proceedings: advisory workshop to identify research needs on the formation of acid precipitation. Workshop report.** Pack, D.H. (ed.). (Sigma Research, Inc., Richland, WA (USA)). May 1979. 265p. (CONF-780850—). P 12/MF A01.

From Workshop to identify research needs on the formation of acid precipitation; Alta, UT, USA (22 Aug 1978).

Results of an advisory workshop sponsored by the Electric Power Research Institute to identify research needs on the formation of acid precipitation are presented. The state of knowledge on instrumentation and sampling, atmospheric chemistry, cloud processes, meteorological transport, and mathematical modeling related to acid precipitation is described. Thirty-eight research projects spanning five areas - instrumentation, field studies, modeling, laboratory studies, and data analysis and interpretation - are described, along with a background discussion of rationale and resources required. The total program described encompasses 210 professional man-years of effort and an estimated cost of $20 million.

53597 (LBL—9037) **Carbonaceous particles in the atmosphere.** Novakov, T. (ed.). (National Science Foundation, Washington, DC (USA); California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1979. Contract W-7405-ENG-48. 285p. (CONF-7803101—). P 13/MF A01.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

The forty-two papers presented at the conference are divided into four categories: analysis, speciation, and behavior; transport, formation, and reactions; chemical structure and biological effects; and sources and physical properties. Each paper has been abstracted and indexed individually for ERA/EDB. (JGB)

53598 (LBL—9037, pp 3-9) **Some analytical approaches to the chemical characterization of carbonaceous particulates.** Malissa, H. (Technical Univ., Vienna, Austria). Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

The concept of systematic integrated dust analysis (SIDA), developed for the overall characterization of aerosol particles in terms of size distribution and chemical composition, includes the analysis of carbonaceous material. Size-segregated sampling is accomplished by a Berner ring jet impactor. Thermoanalytical methods (based on combustion of the sample in O_2) using relative conductimetric detection of evolved CO_2 and SO_2 enable temperature-dependent analyses of C and S species. About 50 μg of sample material is needed for such analyses. Flame ionization detection provides information on the volatility of carbonaceous fractions in N_2 as a function of temperature. These methods allow us to classify carbonaceous materials as: (1) organic compounds volatile in N_2 and/or decomposing in O_2 at low temperatures; (2) soot; and (3) inorganic compounds (carbonates) decomposing at high temperatures. Typical analyses are given; and the role of other methods of SIDA in providing additional information is described. These methods include electron probe microanalysis, secondary electron microscopy, atomic absorption spectroscopy, infrared spectroscopy, and potentiometric analysis.

53599 (LBL—9037, pp 10-13) **Analysis of volatilizable and elemental carbon in ambient aerosols.** Johnson, R.L.; Huntzicker, J.J. (Oregon Graduate Center, Beaverton). Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

An instrument capable of measuring both the volatilizable and elemental carbon fractions of carbonaceous aerosol on a single filter sample is described. The principle of the method is the familiar one of oxidation of the carbon to CO_2, reduction of the CO_2 to CH_4, and measurement of the CH_4 in a flame ionization detector. Organic carbon and carbonates are volatilized at 580°C in a He atmosphere and oxidized to CO_2 by MnO_2 at 850°C in the first part of the analytical cycle. Elemental carbon is measured in the second half of the cycle by oxidation in a He—O_2 atmosphere and chromatographic separation of the O_2 and CO_2. Carbonates can be separated from the organic carbon by acidification of the filter. The complete analytical cycle requires about 30 minutes. The lower limit of detection is determined primarily by the black concentration on the filter, the absolute limit being substantially less than 1 μg.

53600 (LBL—9037, pp 14-24) **Analysis of adsorbed species of commercial polymeric carbons.** Fitch, W.L.; Smith, D.H. (Stanford Univ., CA). Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

A review of the important forms of polymeric carbon (graphitic carbon) is presented. Research directed toward the analysis of polymeric carbon and materials adsorbed on it is described. A new, simple method for measuring the adsorptivity of polymeric carbons, utilizing tritium-labeled benzo[a]pyrene, was developed. Benzene/methanol extraction and analysis by combined gas chromatography/mass spectrometry indicates the presence of a series of oxidized polynuclear aromatic hydrocarbons (PAH) as adsorbates on commercial carbon black samples. The implications of this work for the study of environmental polymeric carbons are discussed.

53601 (LBL—9037, pp 25-29) **Cyano-arenes produced by the combustion of nitrogen containing fuels.** Dubay, G.R.; Hites, R.A. (Massachusetts Inst. of Tech., Cambridge). Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

Cyanonaphthalenes (both isomers) and cyanoacenaphthylenes (four isomers) were identified in the soot generated by the combustion of aromatic hydrocarbon fuels doped with 6 to 30% pyridine. These are by far the most abundant nitrogen containing organic compounds in this combustion effluent; multi-ring, nitrogen heterocyclic compounds, such as those commonly observed in airborne particulate matter, are a minor component. These identifications have been made by gas chromatographic mass spectrometry following a preliminary separation by alumina column chromatography. The environmental significance of these findings is discussed.

53602 (LBL—9037, pp 30-35) **Contribution of high-resolution mass spectrometry to speciation of particulate carbon.** Cronn, D.R. (Washington State Univ., Pullman). Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

The analytical technique to be discussed was developed as a result of interest in the molecular nature of atmospheric aerosols. Particular attention was given to the organic material present in photochemical smog in field studies in St. Louis and Los Angeles. Quantitative molecular information is obtained by computer-controlled, high-resolution, mass spectrometric thermal analysis (HRMSTA). A descriptive explanation of the technique is given. Examples which demonstrate the utility of the method as well as the unique information available from the method are presented.

53603 (LBL—9037, pp 36-48) **Analysis of carbonaceous particulates and characterization of their sources by low-level radiocarbon counting and pyrolysis/gas chromatography/mass spectrometry.** Currie, L.A.; Kunen, S.M.; Voorhees, K.J.; Murphy, R.B.; Koch, W.F. (National Bureau of Standards, Washington, DC). Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

The chemical nature and fossil fuel contribution to urban, rural, and indoor atmospheric carbonaceous particulate samples have been studied by a combination of pyrolysis/gas chromatography/mass spectrometry (Py/GC/MS) and low-level miniradiocarbon counting. The latter method is applied here for the first time to just milligram amounts of atmospheric particulate material (~ 10 mg carbon), and it has shown a striking difference between the biogenic/fossil carbon content of urban and desert samples. Application of Py/GC/MS to the insoluble carbonaceous fraction has provided information on sources and characteristics of the primary carbonaceous material.

53604 (LBL—9037, pp 49-55) **Identification of the graphitic carbon component of source and ambient particulates by Raman spectroscopy and an optical attenuation technique.** Rosen, H.; Hansen, A.D.A.; Gundel, L.; Novakov, T. (Univ. of California, Berkeley). Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

A series of experimental results indicates that the high optical absorptivity of aerosol particles in urban environments and particles generated from various combustion sources is due to their graphitic carbon component.

53605 (LBL—9037, pp 56-58) **Mass monitoring of carbonaceous aerosols with a spectrophone.** Truex, T.J.; Anderson, J.E. (Ford Motor Co., Dearborn, MI). Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

The feasibility of using light absorption as an in situ mass monitor for carbonaceous aerosols was studied. The absorption measurements were made using a helium—cadmium laser with a measured output of 3 MW at 4166A chopped at 4000 Hz to power an acoustically resonant spectrophone. Coupling of the spectrophone with a laboratory flow tube system for generating carbonaceous aerosols has produced the following results: spectrophone output is proportional to carbonaceous aerosol mass concentration as independently determined by filter collection and weighing; the absorption

coefficient of the carbonaceous aerosols is 17 m^2/gm at 4166A in rough agreement with previously measured values for bulk carbon and graphite samples of 1.4 to 15.0 m^2/gm. The spectrophone provides a means of continuous monitoring of carbonaceous aerosols and is far less time-consuming than filter collection techniques. Potential applications include real time monitoring of vehicle exhaust, laboratory combustion research studies and field measurements.

53606 (LBL—9037, pp 59-69) **Detection and identification of airborne carbonaceous matter with a Raman microprobe.** Etz, E.S.; Blaha, J.J.; Rosasco, G.J. (National Bureau of Standards, Washington, DC). Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

The laser-Raman microprobe was used in the spectroscopic characterization of carbonaceous matter associated with air pollution particulate samples. Two types of investigations are described. In the first, the new instrument is applied to the molecular analysis of single microparticles in urban air particulate samples. Of particular interest is the study of the origin and spectral behavior of two bands centered at ~ 1350 and ~ 1600 cm^{-1} frequently observed in the spectra of carbonaceous particles. The effects of laser irradiance conditions used in the measurement on the appearance of these bands is examined. The results of modeling experiments demonstrate that these two bands can be attributed to elemental carbon with structures similar to polycrystalline graphite. In air particulates, the source of this carbon can be either graphitic soot or residual organic matter which converts to polycrystalline graphite on exposure to high-intensity laser radiation. The second study evaluates the analytical potential of micro-Raman spectroscopy (MRS) in the trace characterization of solid organic pollutants. In these experiments, the microprobe is used to obtain vibrational Raman spectra of microsamples of polynuclear aromatic hydrocarbons (PAHs). Potential interference arising from sample heating and sample fluorescence are examined. The PAHs are measured as single microparticles, generally of size 2 to 10 μm, and include representative compounds of the 3-ring (e.g., phenanthrene) and 4-ring (e.g., chrysene, pyrene, fluoranthene) systems. The Raman spectra of these organic solids are highly characteristic of crystal lattice (external) and molecular (internal) vibrations. They can therefore form a basis for the positive identification of the compounds in this class.

53607 (LBL—9037, pp 70-78) **Determination, speciation, and behavior of particulate carbon.** Macias, E.S.; Delumyea, R.; Chu, L.C.; Appleman, H.R.; Radcliffe, C.D.; Staley, L. (Washington Univ., St. Louis, MO). Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

Two compatible methods for carbon analysis of atmospheric fine particles are presented. The amount of soot (as elemental carbon) is determined from the reflectance of an aerosol filter sample. The sample is then analyzed by the gamma ray analysis of light elements (GRALE) technique to determine the total carbon. Organic carbon is determined from the difference between total carbon and soot. Results are presented for the soot, organic and total carbon content of aerosol samples collected in St. Louis during the summer of 1977 and the winter of 1977/1978.

53608 (LBL—9037, pp 79-83) **Organic matter in New York City TSP: comparisons of seasonal variations and relationships to source tracers.** Kneip, T.J. (New York Univ., NY); Leyko, M.A.; Kleinman, M.T.; Lippmann, M.; Daisey, J.M. Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

Total suspended particulate matter (TSP) samples from New York City were extracted sequentially with cyclohexane, dichloromethane, and acetone. The masses of extractable material were compared to older data obtained by benzene/acetone extractions and were examined for correlations to several trace elements and other indices of pollutant sources. The results indicate that the extractable organic matter has not shown any obvious trends during the period 1968 to 1977 when the concentrations of TSP and several elements declined markedly. The correlations indicate that source allocations may be successfully made with more complete data. Local sources (autos and oil burning) appear to be related to the moderately polar and more polar fractions, while oxidants (photochemical reactions) may influence the concentration of the moderately polar material in the summer.

53609 (LBL—9037, pp 84-92) **Diurnal and spatial variations of organic aerosol constituents in the Los Angeles basin.** Appel, B.R.; Hoffer, E.M.; Kothny, E.L.; Wall, S.M.; Hik, M.; Knights, R.L. (California State Dept. of Health, Berkeley). Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

Two-hour and fourteen-hour hi-vol aerosol samples were collected simultaneously at Pasadena, Pomona, and Riverside, California on four successive days in July 1975. Simultaneous ozone and visibility measurements were made for correlation with aerosol constituents. Samples were analyzed for primary (C/sub p/), secondary (C/sub s/), and elemental carbon (C/sub e/) by selective solvent extraction-carbon analysis. In addition, high resolution mass spectrometry was used to provide detailed analysis of organic constituents and to evaluate the selective extraction procedure. The composition of the carbonaceous material at the three sites was found to be similar with C/sub s//C/sub p/ ≧ 2. The C/sub e/, as estimated by insoluble carbon, was the most abundant carbon form. Adipic and glutaric acids were among the more abundant aerosol constituents of probable secondary origin. Elevated morning levels of C/sub s/, dicarboxylic acids and acid nitrates as well as low morning Br/Pb ratios gave evidence of the retention of secondary organic aerosol from preceding days. Cycloalkenes appear to be the principal secondary organic aerosol precursor. Primary organics show evidence of a motor vehicle origin plus additional unidentified sources. Comparison between 2-hour and 14-hour samples reveals evidence of both loss of organics by volatilization and increased collection efficiency for organics with increased particle loading.

53610 (LBL—9037, pp 95-101) **Long distance transport of carbonaceous matter.** Brosset, C. (Swedish Water and Air Pollution Research Lab., Gothenburg). Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

In Sweden carbonaceous particles have been measured during many years. Sampling has been carried out in urban as well as in rural sites. Measurement results from rural sites have been compared with wind-trajectories. Noticeable flows of carbonaceous particles from Central Europe towards Scandinavia have been observed. The size of long-distance transported carbonaceous particles are in general less than 2 μm (aerodynamic diameter). They are probably generated mainly through coal combustion and contain, as a rule, more or less acid ammonium sulfate. They have catalytic ability to oxidize SO_2. In this respect they differ from in Sweden emitted particles which mainly derive from oil combustion. Thus in the air above a Swedish urban site the oxidation of SO_2 is faster in the presence of larger concentrations of long-distance transported carbonaceous particles than otherwise. The same type of catalytic effect has been found even in precipitation. At the present, it is not clear if the catalytic effect of the particles should be ascribed to their concentration of graphite or of certain metals.

53611 (LBL—9037, pp 102-106) **Carbon in Denver's urban plume.** Durham, J.L. (Environmental Protection Agency, Research Triangle Park, NC); Patterson, R.K.; Draftz, R.G. Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

Field data collected in Denver during air pollution episodes in November 1971 and November 1973 are examined. Optical and scanning electron microscopy of size resolved aerosol samples collected downwind of Denver in the urban plume showed that the coarse aerosol principally consists of mineral dust, while the submicrometric fraction is dominated by auto exhaust aerosols. Chemical analyses of the fine aerosol fraction revealed that carbon (total), nitrate, sulfate, and lead accounted for 54 to 70% of the mass on episode days, and only 33% on a clean day in 1971. Chemical analysis of two combined samples for November 16 and 17, 1973 accounted for 70% of the fine aerosol mass as: nonpolar organics, sulfates, lead, nitrates, and ammonium. The nonpolar organics consisted of 76% carbon, which permitted elemental (amorphous/graphitic) carbon concentrations to be estimated at 1.7 to 4.4 micrograms/m^3 for episode days. The results tend to indicate little or no photochemical activity in Denver's urban plume.

53612 (LBL—9037, pp 107-115) **Secondary organic aerosols: identification and mechanisms of formation.** Grosjean, D. (Univ. of California, Riverside). Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

Secondary organic aerosols were studied, with emphasis on their identification and modes of formation. Recent outdoor smog chamber studies of aerosol formation from cyclohexene, toluene, diethylhydroxylamine, and amines are presented along with examples of measurements of total organic carbon and of specific secondary organic aerosols on visibility, their possible health effects and their relative importance in urban atmospheric pollution.

53613 (LBL—9037, pp 116-121) **Optical characterization of ambient and source particulates.** Hansen, A.D.A.; Rosen, H.; Dod, R.L.; Novakov, T. (Univ. of California, Berkeley). Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

The high optical absorptivity of urban particulates is used as a tracer for the graphitic component of the carbonaceous aerosol. The results of the analyses of over 900 ambient samples collected over a wide range of atmospheric conditions show a strong correlation between the graphitic and the total carbon content of the aerosol. No systematic difference in the correlation is observed under condi-

tions of high or low ozone, indicating that ozone-related reactions do not produce substantial quantities of secondary particulates. A comparison between these measurements and similar measurements on sources indicates that a major component of the urban carbonaceous aerosol is due to primary emissions.

53614 (LBL—9037, pp 122-130) **Catalytic oxidation of SO_2 on carbon in aqueous suspensions.** Chang, S.G.; Brodzinsky, R.; Toossi, R.; Markowitz, S.S.; Novakov, T. (Univ. of California, Berkeley). Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

Combustion-produced soot particles are efficient catalysts for SO_2 oxidation, especially when surrounded by a layer of liquid water. Liquid water may dissolve the species formed on particle surfaces and thus regenerate the catalytically active sites. A kinetic study of the catalytic oxidation of SO_2 on soot particles suspended in water was carried out. The reaction was found to be first order with respect to the concentration of carbon, 0.69/sup th/ order with respect to dissolved oxygen, and independent of the concentration of sulfurous acid and the pH under the conditions of our investigation. The activation energy of the reaction is 11.7 kcal/mole. A four-step mechanism is proposed for this soot-catalyzed oxidation reaction. A box-type calculation was carried out to compare the relative importance of soot-particle-catalyzed SO_2 oxidation with other SO_2 oxidation reactions involving liquid water. The results indicate that the soot-catalyzed reaction can be the dominant mechanism for SO_2 oxidation under realistic atmospheric conditions.

53615 (LBL—9037, pp 131-132) **Oxidation of sulfite by activated charcoal.** Eatough, D.J.; Green, W.P.; Hansen, L.D. (Brigham Young Univ., Provo, UT). Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

One possible mechanism for the conversion of SO_2 to sulfate in atmospheric aerosols is the catalyzed conversion on soot particles. Previous work has indicated that activated charcoal is a good model for this catalytic conversion. A calorimetric study of the conversion of sulfite to sulfate in aqueous suspensions of activated charcoal is reported. The results indicate that groups are present in the charcoal which are capable of complexing with sulfite and rapidly oxidizing sulfite to sulfate, resulting in the formation of new reduced species in the charcoal. This reaction mechanism does not appear to involve simple reaction with surface adsorbed oxygen. The rate limiting step for oxidation of sulfite by the charcoal will be the oxidative regeneration of this active site.

53616 (LBL—9037, pp 133-140) **Carbonaceous particulates in the atmosphere: illumination by electron microscopy.** Russell, P.A. (Univ. of Denver, CO). Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

Particulates in the submicrometer size range, collected from four western states, were examined by analytical electron microscopy; carbonaceous particulates usually were the predominant species observed. Whenever non-mineral sulfur was present in the samples examined, it was always observed to be associated with these carbon particles. In most cases, varying levels of associated sulfur did not affect particle size or morphology. Using electron diffraction and particulate thermal characteristics, it was unequivocally demonstrated that particulates of ammonium sulfate, ammonium hydrogen sulfate, sulfamic acid, and sulfuric acid were not present among any of the samples examined.

53617 (LBL—9037, pp 141-144) **Preliminary observations of SO_2-soot interaction by controlled atmosphere transmission electron microscopy.** Chung, T.T.; Dash, J.; O'Brien, R.J. (Portland State Univ., OR). Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

Using a special chamber, it was possible to observe directly in the transmission electron microscope the interaction of soot with a mixture of SO_2, O_2, and H_2O gases. Growth occurred on the soot, and subsequent passage of NH_3 over the soot produced additional growth. No crystalline products were observed in the in situ experiments, but a similar experiment outside the microscope did produce a small amount of crystalline product.

53618 (LBL—9037, pp 145-149) **Importance of carbonaceous particles to the heterogeneous formation of sulfate in plumes.** Freiberg, J. (Rutgers—the State Univ., New Brunswick, NJ). Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

Yield expressions were developed for heterogeneous oxidations occurring in expanding plumes with and without the participation of carbonaceous particles. The expressions are functionally different from each other, but they indicate that all the oxidations proceed not to completion but to fractional asymptotic limits. Most of the oxidation occurs near the SO_2 source, rather than uniformly throughout the expanding plume. The yield expressions are scaled to a chemistry-dispersion ratio for purposes of comparing their respective sensitivities to dispersion. At equal ratios and equal downwind distances, the yield of oxidation in the presence of carbonaceous particles is higher than that of oxidation in the absence of particles. The differences in yield are greatest if the ratio is small and least if the ratio is large.

53619 (LBL—9037, pp 150-154) **Capture of atmospheric gases by water vapor condensation on carbonaceous particles.** Matteson, M.J. (Georgia Inst. of Tech., Atlanta). Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

The oxidation of SO_2 and interaction of NO_2 with suspended carbonaceous particles (SCP) have been demonstrated by several research laboratories. Reaction rates in the aqueous phase are usually a function of the concentration of dissolved gaseous reactant. The work reported here deals with a mass transfer mechanism which enhances the concentration of dissolved gases absorbed by SCP via water vapor condensation. In the first phase of these investigations, large (D = 2 to 3 mm) cold (5 to 7°C) water droplets were suspended in warm (25 to 30°C) nitrogen containing various concentrations of water vapor and a representative atmospheric gas (SO_2, O_2, or NO_2). The gas was absorbed by the water droplet during the water vapor condensation process and the droplet collected after various periods of exposure. The droplet temperature was monitored with a hypodermic probe and the amount of condensed water calculated from this time-temperature profile. The amount of dissolved gas was measured upon collecting the droplets and time-concentration profiles were compared for the various condensation rates. All three gases were absorbed at concentrations several levels greater than when no water vapor condensation was taking place. These results are correlated with the concentrations of the gas and the water vapor in N_2. The results support the fact that non-steady state mass transfer via water vapor condensation is a strong mechanism for concentrating atmospheric gases on SCP. This type of mechanism occurs frequently in smoke plume formation at stack exits, and in cloud formation in the atmosphere. A comparison of time scales for the competing processes which utilize the dissolved gases will determine which chemical reactions are affected.

53620 (LBL—9037, pp 155-166) **Catalytic reactivity of airborne particulate material.** Menotti, F. (Rensselaer Polytechnic Inst., Troy, NY); Hudson, J.B.; Cheng, R.J.; Mohnen, V.A. Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

The surface of airborne particulates may offer a convenient channel for the turnover of gaseous pollutant species by catalytic reactions. A combination of modern surface research techniques is being used to investigate the rate of reactions of potential interest in air pollution on the surface of both real and simulated particulate materials. Initial studies of particulate materials from both oil and coal-fired power plant boilers by Auger Electron Spectroscopy (AES) showed significant amounts of metal oxides, especially vanadium and iron. Qualitative studies of sulfur uptake on laboratory-prepared iron and vanadium oxide samples indicated significant uptake of sulfur on exposure to SO_2 gas at 100°C. Quantitative studies of SO_2 adsorption and reaction on two different vanadium oxide surfaces, by a combination of AES and molecular beam mass spectrometric techniques, demonstrate that SO_2 is adsorbed non-dissociatively and reversibly on both VO and V_2O_5 surfaces. In the case of VO, the resulting adsorbed species reacts with gaseous O_2 in a process that is first order in oxygen pressure. Studies of the reactivity of adsorbed SO_2 on V_2O_5 are continuing, and will be extended to studies on actual airborne particulate surfaces.

53621 (LBL—9037, pp 201-208) **Size distribution and physical properties of combustion aerosols.** Whitby, K.T. (Univ. of Minnesota, Minneapolis). Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

The results from combustion aerosol research on diffusion flames, premixed propane flames, diesel aerosols, and aerosols from automobiles on Los Angeles freeways and from catalyst-equipped cars are described. Aerosol size distributions were modeled by fitting three log-normal distributions to the observed modes. The nuclei mode usually has a geometric mean diameter by volume, DGV/sub n/, in the 0.005 to 0.04 μm range, and a σ/sub g/ in the 1.3 to 1.7 range, and may account for most of the aerosol mass for clean-burning fuels such as propane or methanol. The accumulation mode usually has a size in the 0.15 to 0.5 μm range with a σ/sub g/ of from 1.6 to 2. The higher the concentration of aerosol, the greater the mass fraction found in the accumulation mode. If the log of the mass concentration of combustion aerosols is plotted vs. the log of DGV overall, then most rapidly diluted combustion aerosols are found to the left of a line given by mass concentration, $\mu g\ cm^{-3}$, = $1.14 \times 10^{8}(DGV)^{6.35}$. It was found that the exhaust aerosol from moving vehicles is diluted very rapidly by 10^3 to 10^4, effectively

stopping coagulation and condensation after the aerosol leaves the exhaust pipe.

53622 (LBL—9037, pp 209-211) **Role for carbon and carbon compounds in the particulate emissions of small wood stoves.** Butcher, S.S. (Bowdoin College, Brunswick, ME). Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

Emission factors for particulate matter were measured for small wood stoves operated under a variety of conditions. The emission factors, which range from 1 to 25 g(particulate matter)/kg(fuel), may be represented as a simple function of stove operating parameters. The particulate matter samples lose up to 55% of their weight on heating to 175°C, indicating that a substantial portion of the material collected on the filters consists of volatile or decomposable organic matter.

53623 (LBL—9037, pp 212-215) **Dynamics of sampling and measurement of diesel engine exhaust aerosols.** Kittelson, D.B.; Dolan, D.F. (Univ. of Minnesota, Minneapolis). Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

The dynamics of sampling and measurement of diesel exhaust aerosols were examined, and the results of measurements made on the exhaust of a single cylinder prechamber diesel engine are presented. Diesel engine exhaust aerosols appear to consist primarily of approximately 0.02 μm diameter carbonaceous nuclei which have grown by coagulation into chain aggregates of approximately 0.1 to 0.2 μm diameter. These aggregates may also contain condensed hydrocarbons, sulfates, and other materials. The form in which these particles appear in the atmosphere depends not only upon processes occurring inside the engine and exhaust systems, but also upon the dynamics of the process of dilution in the exhaust plume, and finally upon coagulation and condensation processes which occur after emission into the atmosphere. Because of the complex nature of these interactions, great care must be taken in attempting to relate laboratory measurements of diesel exhaust aerosols with their potential atmospheric impact. In this study an electrical aerosol analyzer, transmission electron microscope, and filter sampler were used in conjunction with a rapid dilution sampling system for measurements of particle size distribution, particle morphology, and total particle mass concentration. Particle size distributions were found to be bimodal with modes at approximately 0.02 and 0.10 μm diameter. Total aerosol mass concentrations in the exhaust were found to vary from about 10 to 110 mg m^{-3} and depended on engine load and fuel.

53624 (LBL—9037, pp 216-220) **Analysis of carbonaceous diesel emissions.** Seizinger, D.E. (Bartlesville Energy Research Center, OK). Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

Carbonaceous diesel emissions were sampled before and after exhaust treatment devices - catalyst, particulate trap, and water scrubber - for determination of particulate size distribution, particulate mass loading, polynuclear aromatics levels, and hydrocarbon character. Results show particulate size was on the order of 0.1 micron mass median diameter. Although the exhaust treatment systems exhibited no significant effect on particulate size, mass loading was reduced from 20 to 70% dependent on device. Polynuclear aromatics and hydrocarbon levels were reduced after exhaust treatment with the degree of reduction dependent on engine speed and load.

53625 (LBL—9037, pp 221-228) **Particulate organic matter and total carbon from vehicles on the road.** Pierson, W.R. (Ford Motor Co., Dearborn, MI). Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

Experiments in urban and highway vehicle tunnels indicated the emission rates and characteristics of carbonaceous aerosol directly emitted by vehicles on the road. Advantage was taken of the fluctuations in traffic composition to differentiate the emissions according to vehicle type. The heavy-duty diesel trucks play the dominant role, emitting some 700 mg/km of aerosol carbon, elemental and combined. Carbonaceous material comprises some 2/3, by mass, of the vehicle aerosol. The elemental and combined carbon are present in comparable amounts, the latter primarily as long-chain alkanes. The particles have large surface areas, reaching 90 m^2/g when the hydrocarbon material is extracted, suggesting structures that are very porous and very much plugged with hydrocarbon material. Perhaps it is for this reason that the oxidation of SO_2 to sulfate on the vehicle aerosol particles is only ~ 2% even after several minutes residence time in the tunnel. Light scattering by the vehicle aerosol is inefficient and appears minor compared to light absorption, mostly by the carbon from diesels. A simple projection of urban aerosol loadings indicates that extensive conversion from gasoline to diesel automobiles could add a considerable amount of carbonaceous aerosol.

53626 (LBL—9037, pp 229-232) **Carbonaceous particles in coal fly ash.** Fisher, G.L. (Univ. of California, Davis); Chrisp, C.E.; Hayes, T.L. Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

The relative mass contribution and numerical abundance of carbonaceous particles in coal fly ash is described. The materials studied were stack-collected fly ash samples obtained by in situ size-classification into four fractions. The carbon content based on residue analysis of the four fractions was less than 0.3% of the total mass. Light microscopic analysis indicated tht the abundance of carbonaceous particles was small relative to other particle types. Single particle x-ray analysis supported the light microscopic identification of the carbonaceous particles. The relative abundance of carbonaceous particles increased with the size of the particulate fractions. In contrast, mutagenicity studies indicated increased biological activity with decreasing particle size.

53627 (LBL—9037, pp 233-244) **Biogenic lipids in eolian particulates collected over the ocean.** Simoneit, B.R.T. (Univ. of California, Los Angeles). Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

The elemental and mineralogical composition and the microfossil and detritus content of particulate fallout from the lower marine troposphere has been extensively documented in earlier work, and it was possible to associate terrigenous source areas with such fallout. The lipids of eolian dusts trapped from the lower tropospheric air mass over the Atlantic, Pacific, and Indian Oceans, and Sea of Japan were investigated in this work. The solvent soluble organic matter consists mainly of normal alkanes (C_{25} to C_{33}, strong odd-to-even carbon number predominance), fatty acids (C_{12} to C_{26}, strong even-to-odd carbon number predominance), and fatty alcohols (C_{12} to C_{30}, even-to-odd carbon number predominance), with relative amounts and molecular weight distributions varying according to the terrigenous source area. These lipids have distributions predominantly characteristic of vascular plant waxes. The nonsoluble organic matter consists mainly of plant detritus, carbon particulates and probably humates. Compound distribution patterns attributable to terrigenous sources, superimposed on the autochthonous marine lipids have been described for Deep Sea Drilling Project sediment samples from the North Atlantic Ocean, where no potamic influx was evident. The major terrigenous compound series encountered are normal alkanes maximizing at C_{29} or C_{31} with strong odd-to-even carbon number predominances and normal fatty acids maximizing at C_{24} or C_{26} with strong even-to-odd carbon number predominances. Based on these data it was concluded that the organic compound distributions and the mineralogy of eolian dusts could be correlated with the same species in certain deep sea sediments. Hence, eolian transport can contribute significant amounts of organic matter to certain marine sedimentary environments over geologic time periods.

53628 (LBL—9037, pp 245-246) **Effect of carbon particles on atmospheric radiation.** Bergstrom, R.W. (Systems Applications, Inc., San Rafael, CA). Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

The solar radiation absorption properties of graphitic carbon and soots are well documented. What is not as well known is that small carbon particles less than 0.1 μm in radius are extremely effective absorbers per unit mass; this suggests that a small amount of submicron particles of graphitic carbon has a large effect on atmospheric radiation. The absorption and light scattering per unit mass for a variety of indices of refraction are shown. For nonabsorptive particles, those from 0.1 to 1 μm in radius are the most effective light scatterers per unit mass, thus explaining the importance of secondary aerosols to visibility and atmospheric radiative properties. As the absorption index increases, small particles become more effective scatterers per unit mass. The effects of small amounts of submicron carbon particles on atmospheric radiative properties are discussed, with emphasis on the various processes that govern the energetics of highly absorbing particles.

53629 (LBL—9037, pp 247-251) **Optical properties of urban aerosols containing carbonaceous material.** Patterson, E.M. (National Center for Atmospheric Research., Boulder, CO). Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

The imaginary index of refraction for Denver, Colorado urban aerosols was measured. The absorptive properties of these aerosols are strongly influenced by the absorptive properties of both elemental carbon and the benzene soluble organics. The consequences of the change in absorption due to the carbonaceous compounds on the optical effects of the aerosol are discussed.

53630 (LBL—9037, pp 252-256) **Light absorption measurements in Europe.** Heintzenberg, J. (International Meteorological Inst., Stockholm, Sweden). Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

European studies on the absorption of electromagnetic radiation by atmospheric aerosol particles in the wavelength range 0.2 to 17 μm are reviewed, starting with the first radiation models which incorporated light absorption. Mass absorption indices derived with an integrating sphere and a spectrometer from impactor aerosol samples under various continental and maritime conditions are shown. The paper includes results for size-segregated aerosol samples together with those for precipitation residues and fog-activated aerosol samples. In a preliminary analysis of the latest field experiment in southern Sweden a combination of optical and chemical characteristics of the haze layer over Europe is presented.

53631 (LBL—9037, pp 257-262) **Studies of the optical, physical and chemical properties of light absorbing aerosols.** Weiss, R.E. (Univ. of Washington, Seattle); Waggoner, A.P.; Charlson, R.J.; Thorsell, D.L.; Hall, J.S.; Riley, L.A. Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

The optical, physical and chemical characteristics of light absorbing aerosol particles were investigated and the results for several urban and rural locations were compared. In addition, a simple technique for measuring the absorption coefficient of an aerosol is discussed and calibration results are shown. The results indicate that the average values of the single particle scattering albedos range from 0.5 to 0.7 for urban areas and 0.8 and 0.95 for rural areas. With the exception of samples from Barbados, B.W.I. absorption was wavelength independent for all sampling locations. Particles of diameter less than 2.5 μm dominated absorption at all sites where the aerosol was size fractionated. Solvent washes of nuclepore filters containing aerosol removed most of the aerosol mass but essentially none of the gray absorbing material, indicating it is probably a graphite-like material (e.g., soot).

53632 (LBL—9037, pp 263-264) **Effect of carbonaceous particles on visibility.** Cahill, T.A. (Univ. of California, Davis). Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

Investigations made of factors statistically associated with visibility reduction in four California cities included a short study of the role of fine (<0.6 micron) carbonaceous particles during one summer month in the Los Angeles air basin. Visibility degradation at this site, Los Alamitos, was dominated by intermediate size (0.6 to 3.6 micron) sulfur containing particles, and gaseous NO_2, while negligible improvement in fit resulted through addition of fine carbonaceous particles. However, negligible improvement in fit was also exhibited by fine sulfur containing particles. Intermediate size carbonaceous particles were not studied.

53633 (LBL—9037, pp 265-269) **Measurement of light absorbing aerosols from combustion sources.** Nolan, J.L. (Rhode Island Dept. of Health, Providence). Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

The absorption coefficients of the exhaust gas streams from a forest slash burn, a coal fired boiler, an oil fired home heating furnace, and a natural gas fired home heating furnace were measured by diluting the samples dynamically and analyzing the filters via the Integrating Plate Method. Using a simple inversion technique, the average imaginary index of refraction was then calculated for each source. The results indicated that the forest fire and the coal boiler were not appreciable sources of highly absorbing aerosol. Since the calculated imaginary index of refraction of both the fuel oil and natural gas furnaces were comparable to the value reported for carbon, the particulate emissions from these sources were concluded to be comprised primarily of carbonaceous soot. Finally, an attempt was made to estimate emission rates of soot from these sources.

53634 (LBL—9037, pp 270-277) **Spectrophotometric measurements of extinction.** Hall, J.S.; Riley, L.A. (Lowell Observatory, Flagstaff, AZ). Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

Nighttime extinction measures made with a transmissometer and interference filters over the spectral range of 0.32 to 0.66 μm at ten carefully selected sites are discussed. The main purpose of the program was to obtain absolute and objective baseline data which can be used at some future time for comparison. Data obtained at nine of the ten sites believed to be generally outside the normal air flow patterns from industrial and smog-producing areas have air of very high quality, with aerosol extinction in the visual region of the spectrum of less than a factor of two or three times Rayleigh extinction alone. Several different procedures tried in an effort to make accurate extinction measures in full sunlight are described.

53635 (LBL—9037, pp 278-281) **Light scattering parameters of internal and external mixtures of soot and non-absorbing material in atmospheric aerosols.** Heintzenberg, J. (International Meteorological Inst., Stockholm, Sweden). Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

Extinction, scattering, and absorption coefficients of single particles are calculated allowing three different ways of mixing a fixed volume fraction of soot with non-absorbing ammonium sulfate: one homogeneous sphere with the soot being dissolved in the ammonium sulfate; an external mixture of two independently scattering soot and ammonium sulfate spheres; and two concentric spheres with the soot being the kernel. The results are integrated over Whitby's Los Angeles Grand Average aerosol size distribution to demonstrate the influence of the state of internal or external mixture on the light scattering parameters of an urban aerosol. Four different possibilities of distributing a fixed total soot volume over the three modes of the size distribution were investigated. The calculated light extinction coefficients for the 4 models differ only by 5% while the corresponding scattering coefficients vary by 10% depending on the state of mixture. The absorption coefficients, however, vary by a factor of 3 with changing location of the fixed absorber volume within the particles and/or within the size distribution.

53636 (ORNL—5507) **Model evaluation methodology applicable to environmental assessment models.** Shaeffer, D.L. (Oak Ridge National Lab., TN (USA)). Aug 1979. Contract W-7405-ENG-26. 53p. P 04/MF A01.

A model evaluation methodology is presented to provide a systematic framework within which the adequacy of environmental assessment models might be examined. The necessity for such a tool is motivated by the widespread use of models for predicting the environmental consequences of various human activities and by the reliance on these model predictions for deciding whether a particular activity requires the deployment of costly control measures. Consequently, the uncertainty associated with prediction must be established for the use of such models. The methodology presented here consists of six major tasks: model examination, algorithm examination, data evaluation, sensitivity analyses, validation studies, and code comparison. This methodology is presented in the form of a flowchart to show the logical interrelatedness of the various tasks. Emphasis has been placed on identifying those parameters which are most important in determining the predictive outputs of a model. Importance has been attached to the process of collecting quality data. A method has been developed for analyzing multiplicative chain models when the input parameters are statistically independent and lognormally distributed. Latin hypercube sampling has been offered as a promising candidate for doing sensitivity analyses. Several different ways of viewing the validity of a model have been presented. Criteria are presented for selecting models for environmental assessment purposes.

53637 (ORNL/TM—6933) **User's manual to ABN0X: a computer program designed to simulate the nitrogen oxide removal efficiency of a multistage bubble-cap tower.** Counce, R.M. (Oak Ridge National Lab., TN (USA)). Sep 1979. Contract W-7405-ENG-26. 49p. P 03/MF A01.

ABN0X is a computer program for simulating nitrogen oxide, NO/sub x/, removal from gas streams in a multistage bubble-cap column using water or dilute HNO_3 as the scrubbing liquor. The mathematical equations describing this scrubbing operation were developed from basic diffusional, kinetic, and equilibrium information and are in reasonable agreement with experimental data. The important mechanisms involved in the absorption of gaseous NO/sub x/ compounds with greater than 1 vol % NO_2* ($NO_2 + 2N_2O_4$) are: (1) the absorption of NO_2* resulting in the production of liquid HNO_2 and HNO_3; (2) the dissociation of liquid HNO_2 into liquid HNO_3 and gaseous NO; and (3) the gas-phase oxidation of NO to NO_2. This report gives a detailed description of this simulated scrubbing operation and the input necessary to operate the program. A listing of the computer code is given in the appendix. This report is based on an analysis of the experimental data reported in ORNL-5438.

53638 (PB—290237) **Air quality impacts using SRC versus conventional coal in power plants. Final report, November 1977-September 1978.** Leichter, I.; Koch, R.C.; Nagda, N.L.; Swift, J.L. (Hittman Associates, Inc., Columbia, MD (USA)). Oct 1978. Contract EPA-68-02-2162. 356p. Y A16/MF A01.

The report gives results of air quality modeling to assess the impact of burning solvent-refined coal (SRC) instead of conventional coal in three power plants which exceeded National Ambient Air Quality Standards when burning conventional coal. The EPA CRSTER Gaussian plume model with minor modifications was used to calculate ambient air pollution concentrations (for SO2, NOx, and particulates) when (a) conventional coal and (b) SRC were burned. SRC test burn emissions data were used to determine emission factors for the three pollutants when burning SRC at each plant . The most significant impact of switching from conventional coal to SRC was the reduction of SO2 and particulate concentrations at each plant. The highest 20 maximum 24-hour SO2 concentrations

were reduced by 60-75%. At all three plants, the annual mean particulate concentrations were reduced to essentially background levels when SRC was burned.

53639 (PB—290320) **Ground-based sulfur dioxide measurements within a copper smelter plume - Anaconda, Montana. Final report, October 1976-March 1977.** van Ee, J.J. (Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab.). Sep 1978. 87p. Y A05/MF A01.

The Monitoring Operations Division (MOD) of the Environmental Monitoring and Support Laboratory - Las Vegas developed a mobile sulfur dioxide (SO_2) instrument package for use in the remote, rugged terrain surrounding The Anaconda Company's copper smelter at Anaconda, Montana. The self-contained instrument package was used to obtain ground-level SO_2 measurements in the area impacted by the smelter plume. Wind speed, wind direction, and temperature were also recorded at the sampling site. The requirement for the package to be quickly deployed in an area impacted by the smelter plume necessitated the use of a helicopter to sling-load the package into position. Calibration of the instruments was peformed before and after each sampling period. The primary area of interest for SO_2 measurements was the mountainous terrain south of the smelter. During the 4 active months of the study, the package was deployed 17 times. The primary and secondary SO_2 standards were exceeded on a number of occasions. Source emission strength estimates, obtained by EPA-Region VIII are presented for those times when SO_2 was measured at a site. These data can be used to normalize the recorded SO_2 values to account for the varying SO_2 emissions from the source.

53640 (PB—290362) **Airborne measurements of a copper smelter plume in Montana. The Anaconda Company, Anaconda, Montana. (October 1-December 9, 1976). Final report.** Johnson, F.G.; Mage, D.T.; Cimon, N.J. (Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab.). Sep 1978. 230p. Y A11/MF A01.

A field study was conducted during October 1 to December 8, 1976 to measure parameters of the effluent plume of The Anaconda Company's copper smelter, Anaconda, Montana. Plume parameters were observed with a helicopter-borne air quality monitoring system. This data report presents plume heights, plume horizontal and vertical dispersion, and plume centerline concentration, and low-altitude sulfur dioxide concentrations over areas of plume impaction. Nephelometer and SO_2 data have been adjusted to account for instrument response times.

53641 (PB—291174) **A national environmental/energy workforce assessment. Post-secondary education profile: abstract. Final report on phase 2.** (National Field Research Center, Inc., Iowa City, IA (USA)). Dec 1978. 53p. Y A04/MF A01.

The study aggregates data on representative environmental education offerings in the United States at post-secondary education institutions and in the private sector of the economy. Structured around on-site interviews, the study describes the institutions' education programs--their program structure, representative course offerings, faculty structure, and program requirements. In addition, the study provides information on the employment history of graduates. Designed as Phase II of a three-phase program, the study presents the information on schools in the following volumes: Two volumes on potable water and two on wastewater; one volume each on air, noise, pesticides, radiation, solid waste and energy; a two-volume composite report on environmental engineering/health; a one-volume report on education/ecology; and a volume on some training programs conducted by businesses and by trade and professional associations. In addition, the study includes a one-volume abstract and a one-volume summary. The study is an overview. It doesn't include all environmental programs in the United States, and it makes no attempt to evaluate the program offerings. Other individual documents are also available:

53642 (PB—291175) **A national environmental/energy workforce assessment. Post-secondary education profile: summary. Final report on phase 2.** (National Field Research Center, Inc., Iowa City, IA (USA)). Dec 1978. 124p. Y A06/MF A01.

This study is one of 16 volumes aggregating data on representative environmental education offerings in the United States at post-secondary education institutions and in the private sector of the economy. Structured around on-site interviews, the study describes the institutions' education programs--their program structure, representative course offerings, faculty structure, and program requirements. In addition, the study provides information on the employment history of graduates. Designed as Phase II of a three-phase program, the study presents the information on schools in the following volumes: Two volumes on potable water and two on wastewater; one volume each on air, noise, pesticides, radiation, solid waste and energy; a two-volume composite report on environmental engineering/health; a one-volume report on education/ecology; and a volume on some training programs conducted by businesses and by trade and professional associations. In addition, the study includes a one-volume abstract and a one-volume summary. The study is an overview. It doesn't include all environmental programs in the United States, and it makes no attempt to evaluate the program offerings.

53643 (PB—291176) **A national environmental/energy workforce assessment. Post-secondary education profile: private sector. Final report on phase 2.** (National Field Research Center, Inc., Iowa City, IA (USA)). Dec 1978. 217p. Y A10/MF A01.

This study is one of 16 volumes aggregating data on representative environmental education offerings in the United States at post-secondary education institutions and in the private sector of the economy. Structured around on-site interviews, the study describes the institutions' education programs--their program structure, representative course offerings, faculty structure, and program requirements. In addition, the study provides information on the employment history of graduates. Designed as Phase II of a three-phase program, the study presents the information on some training programs conducted by businesses and by trade and professional associations. The study is an overview. It doesn't include all environmental programs in the United States, and it makes no attempt to evaluate the program offerings.

53644 (PB—291177) **A national environmental/energy workforce assessment. Post-secondary education profile: air. Final report on phase 2.** (National Field Research Center, Inc., Iowa City, IA (USA)). Dec 1978. 369p. Y A16/MF A01.

This study is one of 16 volumes aggregating data on representative environmental education offerings in the United States at post-secondary education institutions and in the private sector of the economy. Structured around on-site interviews, the study describes the institutions' education programs--their program structure, representative course offerings, faculty structure, and program requirements. In addition, the study provides information on the employment history of graduates. Designed as Phase II of a three-phase program, the study presents the information on schools with emphasis on air pollution. The study is an overview. It doesn't include all environmental programs in the United States, and it makes no attempt to evaluate the program offerings.

53645 (PB—291178) **A national environmental/energy workforce assessment. Post-secondary education profile: composite i (environmental engineering/health). Final report on phase 2.** (National Field Research Center, Inc., Iowa City, IA (USA)). Dec 1978. 278p. Y A13/MF A01.

This study is one of 16 volumes aggregating data on representative environmental education offerings in the United States at post-secondary education institutions and in the private sector of the economy. Structured around on-site interviews, the study describes the institutions' education programs--their program structure, representative course offerings, faculty structure, and program requirements. In addition, the study provides information on the employment history of graduates. Designed as Phase II of a three-phase program, the study presents the information on schools with emphasis on environmental engineering/health. The study is an overview. It doesn't include all environmental programs in the United States, and it makes no attempt to evaluate the program offerings.

53646 (PB—291179) **A national environmental/energy workforce assessment. Post-secondary education profile: composite i (cont'd) (environmental engineering/health). Final report on phase 2.** (National Field Research Center, Inc., Iowa City, IA (USA)). Dec 1978. 301p. Y A14/MF A01.

This study is one of 16 volumes aggregating data on representative environmental education offerings in the United States at post-secondary education institutions and in the private sector of the economy. Structured around on-site interviews, the study describes the institutions' education programs--their program structure, representative course offerings, faculty structure, and program requirements. In addition, the study provides information on the employment history of graduates. Designed as Phase II of a three-phase program, the study presents the information on schools with emphasis on environmental engineering/health. The study is an overview. It doesn't include all environmental programs in the United States, and it makes no attempt to evaluate the program offerings.

53647 (PB—291180) **A national environmental/energy workforce assessment. Post-secondary education profile: composite ii (education/ecology). Final report on phase 2.** (National Field Research Center, Inc., Iowa City, IA (USA)). Dec 1978. 333p. Y A15/MF A01.

This study is one of 16 volumes aggregating data on representative environmental education offerings in the United States at post-secondary education institutions and in the private sector of the economy. Structured around on-site interviews, the study describes the institutions' education programs--their program structure, representative course offerings, faculty structure, and program requirements. In addition, the study provides information on the employment history of graduates. Designed as Phase II of a three-phase program, the study presents the information on schools with empha-

sis on education/ecology. The study is an overview. It doesn't include all environmental programs in the United States, and it makes no attempt to evaluate the program offerings.

53648 Objective placement of sensors for a regional turbidity network. Shannon, J.D.; Wesely, M.L. (Argonne National Lab., IL). pp 260-264 of Fifth conference on probability and statistics. Boston, MA; American Meteorological Society (1977).

The Multi-state Atmospheric Power Production Pollution Study (MAP3S) is designed to investigate regional patterns of pollutants (primarily sulfates) in the northeastern quarter of the United States, resulting from the generation of electrical power from fossil fuels. Part of this program is a network of dichopyranometers, silicon-cell pyranometers placed in assemblies that allow determination of the attenuation of direct-beam solar radiation by haze. Site selection fr sensor placement mainly involved only computer simulations. This study describes an objective sensor-placement technique based on data from 24 stations in and around the MAP3S area. Briefly the technique consists of the following steps: obtain data describing the phenomenon of interest; select discrete temporal and spatial separation intervals for which correlation coefficients for the data are to be computed; calculate matrices of correlation coefficients and the associated number of pairs of data points used in calculating each coefficient; select the form of a continuous function, the Correlation Structure Function (CSF), which will be used to model the information contained in the discrete correlation matrices; fit the CSF to the discrete correlations through adjustment of coefficients in the CSF, by Nonlinear Programming (NLP); specify a grid of points covering the geographical region over which objective analyses of the phenomenon will be modeled; make a first guess of sensor positions; shift and optimize sensor positions by use of NLP; and select feasible sites that best approximate the optimized pattern. This technique can be used to improve the existing network as well as aid in site selection for new networks.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 53272, 53477, 53641, 53642, 53643, 53644, 53645, 53646, 53647

53649 (BNWL-SA—6447) **Wind erosion research at an uranium mill tailings site.** Sehmel, G.A. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jul 1977. Contract EY-76-C-06-1830. 5p. (CONF-7709192—1). P 02/MF A01.

From 10. aerosol technology meeting; Albuquerque, NM, USA (26 Sep 1977).

A uranium mill tailings pile at Grants, New Mexico, was selected for wind erosion research since the configuration provides flat area containing fine sand and made up of larger particles. The wind erosion experiment is discussed. Experimental equipment consists of meteorological instrumentation to automatically activate air samplers as a function of wind speed increments and direction, particle cascade impactors to measure airborne respirable concentrations as a function of particle size, inertial impaction devices to measure nonrespirable fluxes of airborne particles, a virtual particle cascade impactor to measure airborne concentrations of toxic trace elements, and soil depth gauges to measure changes in surface soil elevations as a function of time. Both radioactive particles as well as toxic trace element concentrations are measured. Radioactive particles are measured with both particle cascade impactors as well as high-volume air samplers. In contrast, toxic trace element airborne concentrations are measured only with a two-stage virtual particle cascade impactor. Fluxes of nonrespirable airborne particles are measured with inertial impaction devices. At particle cascade impactor sites, a rotating cyclone preseparator collects nonrespirable particles. In addition at all sites, fluxes of nonrespirable particles are measured using an open cavity inertial impaction device. (JGB)

53650 (CONF-7810133—5) **Environmentally important radionuclides in nonproliferative fuel cycles.** Kaye, S.V.; Till, J.E. (Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 22p. P 02/MF A01.

From Radioactivity and environmental meeting; Norderney, F.R. Germany (2 Oct 1978).

Our analyses indicate that more in-depth research should be done on ^{3}H, ^{14}C, ^{99}Tc, and ^{232}U, especially because of their presence in nonproliferative fuel cycles. For increased ^{3}H production by fast reactors, we can only speculate that such research could show that environmental releases might be significantly greater than for LWRs. Carbon-14 will likely not be a problem if a suitable decontamination factor can be agreed upon for reprocessing facilities and if a satisfactory regulatory limit can be established for global populations. Additional experimental research is urgently needed to determine the uptake of low levels of ^{99}Tc by plants. These data are essential before an accurate assessment of ^{99}Tc releases can be made. Finally, we recommend that investigators take a closer look at the potential problems associated with ^{232}U and daughters. This radionuclide could contribute a significant portion of the dose in both environmental and occupational exposures from the nonproliferative fuels.

53651 (NUREG/CR—0553) **Uranium Dispersion and Dosimetry (UDAD) Code.** Momeni, M.H.; Yuan, Y.; Zielen, A.J. (Argonne National Lab., IL (USA)). May 1979. Contract W-31-109-ENG-38. 316p. (ANL/ES—72). P 14/MF A01.

The Uranium Dispersion and Dosimetry (UDAD) Code provides estimates of potential radiation exposure to individuals and to the general population in the vicinity of a uranium processing facility. The UDAD Code incorporates the radiation dose from the airborne release of radioactive materials, and includes dosimetry of inhalation, ingestion, and external exposures. The removal of raioactive particles from a contaminated area by wind action is estimated, atmospheric concentrations of radioactivity from specific sources are calculated, and source depletion as a result of deposition, fallout, and ingrowth of radon daughters are included in a sector-averaged Gaussian plume dispersion model. The average air concentration at any given receptor location is assumed to be constant during each annual release period, but to increase from year to year because of resuspension. Surface contamination and deposition velocity are estimated. Calculation of the inhalation dose and dose rate to an individual is based on the ICRP Task Group Lung Model. Estimates of the dose to the bronchial epithelium of the lung from inhalation of radon and its short-lived daughters are calculated based on a dose conversion factor from the BEIR report. External radiation exposure includes radiation from airborne radionuclides and exposure to radiation from contaminated ground. Terrestrial food pathways include vegetation, meat, milk, poultry, and eggs. Internal dosimetry is based on ICRP recommendations. In addition, individual dose commitments, population dose commitments, and environmental dose commitments are computed. This code also may be applied to dispersion of any other pollutant. (ERB)

53652 (ORP/EERF—79-1) **Study of radon-222 released from water during typical household activities.** Partridge, J.E.; Horton, T.R.; Sensintaffar, E.L. (Environmental Protection Agency, Montgomery, AL (USA). Eastern Environmental Radiation Lab.). Mar 1979. 30p. Eastern Environmental Radiation Facility, P.O. Box 3009, Montgomery, AL.

Small quantities of radon-222 can be found in all ground water from natural sources as a result of decay of radium-226 both in water and the soils and soil matrix surrounding the water. Radon in drinking water has previously been considered a source of radiation exposure primarily from an ingestion standpoint. However, the EPA, Office of Radiation Programs, is investigating the potential for exposure to individuals from inhalation of gaseous radon released from water. This report describes the results of a study to determine the fraction of radon released from water during typical household activities such as clothes washing, dishwashing, showering, etc., and estimates the potential radon concentration in air and resulting working levels in structures.

53653 (PB—291186) **A national environmental/energy workforce assessment. Post-secondary education profile: radiation. Final report on phase 2.** (National Field Research Center, Inc., Iowa City, IA (USA)). Dec 1978. 279p. Y A13/MF A01.

This study is one of 16 volumes aggregating data on representative environmental education offerings in the United States at post-secondary education institutions and in the private sector of the economy. Structured around on-site interviews, the study describes the institutions' education programs--their program structure, representative course offerings, faculty structure, and program requirements. In addition, the study provides information on the employment history of graduates. Designed as Phase II of a three-phase program, the study presents the information on schools with emphasis on radiation. The study is an overview. It doesn't include all environmental programs in the United States, and it makes no attempt to evaluate the program offerings.

53654 (UCRL—52802) **ARAC update: 1979.** Dickerson, M.H.; Knox, J.B.; Orphan, R.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Jul 1979. Contract W-7405-ENG-48. 16p. P 02/MF A01.

The Atmospheric Release Advisory Capability service (ARAC), has three main functions: to provide support to designated Department of Energy facilities during an accidental atmospheric release of radionuclides; to support the DOE Emergency Response Team in the event of potential or actual releases of radionuclides; and to provide the Federal Aviation Administration with dose assessments whenever aircraft could possibly intercept a nuclear debris cloud from a Chinese atmospheric nuclear test. A computer network linking the central facility at Livermore with the Air Force Global Weather Central and the remote DOE sites allows rapid data transmission and analysis. Facilities are described, and tests and

responses of the ARAC system and models from May 1974 to April 24, 1979 are outlined. (JGB)

THERMAL EFFLUENTS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 52822

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 53648

REGULATIONS

REFER ALSO TO CITATION(S) 52429

ENVIRONMENTAL SCIENCES, TERRESTRIAL

BASIC STUDIES

REFER ALSO TO CITATION(S) 53585, 53586, 53587, 53749, 53756

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 53272, 53636, 53641, 53642, 53643, 53645, 53646, 53647, 53653, 53699

53655 (CONF-7806143—, pp 11-13) **Prevention of groundwater pollution from oil storage tanks.** Andersen, L.J. (Geologiske Undersogelse, Kobenhaven, Denmark). 1978.

From International symposium on ground water pollution; Prague, Czechoslovakia (Jun 1978).

Large storage tanks situated at or below the ground surface can be provided with arrangements, which prevent the distribution of an oil pollution of the groundwater and provide possibilities for recovering of the leached oil. The economic consequences are evident, as restoring of oil contaminated aquifers are very expensive. However, the most important condition should be remembered, i.e., the storage tank must be placed where the groundwater table is situated near the ground-surface, as the recovery of spilled oil is dependent on establishing a vacuum in the space below the tank, a surrounding barrier and the groundwater table.

53656 (PB—291183) **A national environmental/energy workforce assessment. Post-secondary education profile: pesticides. Final report on phase 2.** (National Field Research Center, Inc., Iowa City, IA (USA)). Dec 1978. 300p. Y A13/MF A01.

This study is one of 16 volumes aggregating data on representative environmental education offerings in the United States at post-secondary education institutions and in the private sector of the economy. Structured around on-site interviews, the study describes the institutions' education programs--their program structure, representative course offerings, faculty structure, and program requirements. In addition, the study provides information on the employment history of graduates. Designed as Phase II of a three-phase program, the study presents the information on schools with emphasis on pesticides. The study is an overview. It doesn't include all environmental programs in the United States, and it makes no attempt to evaluate the program offerings.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 53272, 53641, 53642, 53643, 53645, 53646, 53647, 53649, 53653, 53725

SOIL

REFER ALSO TO CITATION(S) 52613, 52683

TERRESTRIAL ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 53477, 53650, 53651

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 52515, 52517, 53756

53657 (DOE/SR/01072—2) **Archeological investigations by the Savannah River Plant Archeological Research Program. Annual report, 1978-1979.** Hanson, G.T. Jr.; Brooks, R.D. (South Carolina Univ., Columbia (USA). Inst. of Archeology and Anthropology). Jun 1979. Contract EW-78-S-09-1072. 72p. P 04/MF A01.

Results of surveys of two potential sites for spent fuel storage and waste processing facilities at the Savannah River Plant are discussed. The surveys resulted in the location of ten previously unknown archeological sites of which three were considered worthy of preservation for scientific reasons. Progress is also reported in general research efforts focused on recovery of additional archeological data for use in the preparation of an overall survey study. (JGB)

ENVIRONMENTAL SCIENCES, AQUATIC

53658 (CONF-771114—, pp 331-363) **Thermal ecology and stress: a case history for red-sore disease in largemouth bass.** Esch, G.W.; Hazen, T.C. (Wake Forest Univ., Winston-Salem, NC). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

The stress concept is analyzed and related to individual, population, and ecosystem levels of biological organization. Red-sore disease, produced by the gram-negative bacterium Aeromonas hydrophila, is discussed in terms of its relationship to stress. An effort is made to relate seasonal changes in red-sore disease to environmentally induced alterations in the physiology and behavior of largemouth bass. A hypothesis is proposed to explain these interactions in terms of stress.

BASIC STUDIES

REFER ALSO TO CITATION(S) 52515, 52689, 53585, 53586, 53587, 53749, 53757

53659 (CONF-771114—, pp 19-38) **Frequency response of a marine ecosystem subjected to time-varying inputs.** Dwyer, R.L. (Univ. of Rhode Island, Kingston); Nixon, S.W.; Oviatt, C.A.; Perez, K.T.; Smayda, T.J. Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

Recent studies have drawn conclusions about the stability and linearity of ecosystem response to environmental fluctuations, on the basis of analyses of linear mathematical models of several different ecosystems. The validity of model stability estimates can be verified only by an independent method that is not based on assumptions implicit in the formulation of the model. An independent method for deriving frequency response which uses time-series data for an environmental input to and biological response from an ecosystem is presented. Time series of solar radiation, water temperature, ammonia, and phytoplankton abundance, from weekly samples taken in Narragansett Bay, Rhode Island, over a 17-year period, and time series of ammonia and chlorophyll a from a 6-month sewage-perturbation experiment in the 150-l microcosms simulating Narragansett Bay were analyzed by spectral analysis. Spectra for the environmental inputs to the bay ecosystem showed periodicities only at 1 cycle/year, whereas the spectrum for phytoplankton abundance showed additional significant periodicities at 2 and 4 cycles/year. These were judged to be harmonics resulting from a nonlinearity in the ecosystem. Cross-spectral analysis of inputs vs. phytoplankton abundance showed no evidence of linear frequency response. Inadequacies in experimental design for the microcosm experiment hindered quantitative estimation of microcosm frequency response, but the advantage of microcosms in allowing full control during input—response experiments is shown.

53660 (CONF-771114—, pp 39-48) **Applying survival curves to assessment of fish larval entrainment impact.** Dahlberg, M.D. (NUS Corp., Pittsburgh, PA). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

The equivalent-adults model for approximating number of fish larvae entrained at power plants and survival rates from larva to adult is assessed in regard to predicting the number of adults represented by entrained larvae. The accuracy of this model, in

relation to other proposed approaches, depends on the proper selection of methods for calculating larval losses, lifetime fecundity, and larva-to-adult survival. Additional approaches are recommended when sufficient population data are available. Until questionable assumptions can be resolved, a reasonable approach is to calculate a possible range for the number of equivalent adults lost. These numbers can be compared to a reference of acceptability, such as year-to-year variability of stock size.

53661 (CONF-771114—, pp 49-61) **Simple model for assessing the potential loss of adult fish resulting from ichthyoplankton entrainment.** Saunders, W.P. Jr. (Environmental Research and Technology, Inc., Concord, MA). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

A mathematical model for estimating potential survival of fish eggs and larvae to reproducing adults is examined in the context of predicting the potential loss from power-station entrainment. It is demonstrated that violating one assumption of the model can result in gross underestimates of potential adult loss. High rates of natural mortality occurring during the egg and larval life stages are considered in relation to the assumption that all exploitation by the power plant occurs instantaneously at spawning or hatching. The sensitivity of potential loss estimates to various time—mortality-rate regimes is examined on the basis of the natural mortality rates observed in young life stages of several species. An alternative model is proposed, and its sensitivity to underlying assumptions is examined. This model is shown to consistently overestimate loss of equivalent adults. The magnitude of the overestimation depends on species-specific conformity of the model assumptions to actual planktonic mortality and first-year survival.

53662 (CONF-771114—, pp 102-119) **Ecosystem responses to stress in aquatic microcosms.** Leffler, J.W. (Univ. of Georgia, Athens). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

Ecosystem stress is defined as any change in exogenous inputs which produces an output significantly different from the system's normal response. Any discussion of stress requires a description of the state space in which the ecosystem normally functions. This normal operating range can be either static or dynamic, depending on the time scale of interest. Ecosystem stress responses can be discussed in terms of the system's relative stability. Hypotheses regarding such responses can be empirically evaluated by use of microcosm models. Experiments using aquatic microcosms to evaluate the stabilizing effects of species diversity and nutrient availability are described as examples of this technique. Contrary to previously proposed hypotheses, no relationships between diversity, nutrient availability, or system mass and ecosystem stability, or between ecosystem resistance and resilience stabilities were demonstrated. Data from microcosm studies illustrate the importance of specifying the nature of the perturbation, the parameters used to characterize the system, and the prior history of the system in discussions of an ecosystem's response to stress.

53663 (CONF-771114—, pp 120-140) **Physicochemical and biological stressors as distributional determinants of Caribbean and tropical eastern Pacific swimming crabs.** Norse, E.A. (Univ. of Iowa, Iowa City). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

Zones where influences of terrestrial-limnetic and marine ecosystems overlap provide natural physicochemical stress gradients for groups that evolved at either end. Portunid crabs, originally a marine group, now occur from equable offshore marine biotopes to stressful rivers and streams. Field studies on population and community structure in coastal areas of the eastern Pacific (Colombia, Panama, and Mexico) and the Caribbean (Jamaica, Florida, Curacao, and Colombia) and experiments on physiological tolerances and biological interactions of Caribbean portunids showed that Euphylax robustus in the Pacific and Portunus, Arenaeus, and Cronius spp. in both oceans occur predominantly farther offshore, deeper, or in higher salinities than Callinectes spp., which are more euryhaline than members of the other genera. Among Callinectes, high-temperature and desiccation tolerances are much less important than hyposalinity tolerances in permitting species to penetrate estuaries and shallow areas, and likelihood of severe dilution directly or indirectly limits distributions as stress increases. Seaward distributional limits result from increased interference and exploitation competition, predation, parasitism, decreasing food quantity and quality, and the interactions of these factors. Thus, biological stress increases as physicochemical stress decreases. Distributions of populations along gradients are envisioned as responses to risk of mortality from physicochemical and biological stressors, with abundance peaks corresponding to zones of minimum combined risk.

53664 (CONF-771114—, pp 141-156) **Effects of fluctuating flow rates and water levels on chironomids: direct and indirect alterations of habitat stability.** Covich, A.P.; Shepard, W.D.; Bergey, E.A.; Carpenter, C.S. (Univ. of Oklahoma, Norman). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

Regulation of stream flow-through water storage by hydroelectric dams and flood-control impoundments may alter benthic macroinvertebrate communities that are adapted to distinct seasonal shifts in water levels. Isolating these changes in community structure from changes caused by alterations in water quality is not possible currently because data on effects of fluctuating flow in uncontaminated streams are infrequently reported. Studies from February through August 1977 on the Grand River and two of its tributaries in Oklahoma were conducted at seven stations. Of the 122 taxa of macroinvertebrates collected, 24 were genera or chironomids. Glyptotendipes dominated most locations in terms of density and biomass. Fluctuations in water level and water flow resulting from reservoir discharges were found to influence chironomid populations in both the discharge-receiving river and its two tributaries. Decreased density, biomass, and numbers of genera characterized the most intensely fluctuating sites. Indirect effects on substrate size, composition, and movement, as well as direct washing out of organisms from the substrate, may have caused the relative declines in abundance.

53665 (CONF-771114—, pp 157-175) **Environmental implications of coal-conversion technologies: organic contaminants.** Gehrs, C.W. (Oak Ridge National Lab., TN). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

The Department of Energy is currently supporting development of more than 20 major coal-conversion facilities, with many more in the exploratory and predesign stage. All coal-conversion processes utilize pyrolysis (destructive heating) to produce hydrocarbons enriched in their hydrogen-to-carbon ratio from the parent coal. This entails the use of high temperature, often high pressure, and a reducing atmosphere. The products are easier to handle than the parent coal and are usable in a greater variety of ways. The organic components may reach the aquatic environment, however, from product usage, through leaks, or in plant effluents. This paper briefly describes the conversion technologies, identifies the types of organic contaminants expected to be released, summarizes the literature on environmental effects, and outlines a research strategy for addressing the potential environmental ramifications of organic contaminants released by coal-conversion technologies.

53666 (CONF-771114—, pp 176-187) **Stream environment and macroinvertebrate communities: contrasting effect of mining in Colorado and the eastern United States.** Ward, J.V. (Colorado State Univ., Fort Collins); Canton, S.P.; Gray, L.J. Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

Studies were conducted year-round on a Colorado stream that receives drainage from a coal mine to assess the potential response of macroinvertebrate communities to mining activities in the western United States. Species composition, diversity, and standing crop were examined; and results are compared with similar studies conducted in eastern states. Generally low values of sulfate and iron, highly-buffered waters, and low levels of toxic substances characterized the Colorado stream and applied, in general, to many streams in the western energy-development region. Moderate inputs of soluble salts increased abundance of macroinvertebrates without significant changes in community structure or other discernible indications of stressed conditions. This is attributed to the relatively soft waters above the mine and the protection afforded by a buffer strip between the mine spoils and the stream. Increased salinity, sedimentation, and water depletion are major problems; but, with proper environmental considerations, mining in the West may not have the severe impacts on stream biota which characterize many eastern mining regions.

53667 (CONF-771114—, pp 364-380) **Size-fractionated primary productivity in Lake Michigan near the Kewaunee Nuclear Power Plant.** Zeeman, S.I.; Grunewald, R. (Univ. of Wisconsin, Milwaukee). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

Primary productivity rates were measured at the site of the Kewaunee Nuclear Power Plant from August 26, 1975, to July 23, 1976. Productivity was determined for three size fractions by sequential filtration through 64-, 10-, and 0.45-μm porosity filters. Total unfractionated productivity was also measured. Univariate analysis of variance showed no difference ($P > 0.05$) between pre- and post-condenser productivity rates of the unfractionated samples. Multivariate analysis of variance applied to size-fractionated samples detected lower rates only when there was a ΔT across the condenser. These differences were caused by changes in the <10- and >64-μm fractions. Average productivity rates for the year at the postcondenser station were within 13% of those at the precondenser station. Chlorophyll a values were within 4% of precondenser values. It was concluded that, although individual phytoplankton may be killed by

passage through the cooling system, populations suffer no permanent damage. Both productivity rates and chlorophyll a concentrations for the net plankton (>64 μm) averaged over 55% of the sum of the three fractions. The 10- to 64-μm fraction averaged about 12% for productivity and 24% for chlorophyll, but the values for the <10-μm fraction were about 30 and 20% of the sum of the fractions for productivity and chlorophyll, respectively. Assimilation numbers (milligrams of carbon per milligram of chlorophyll a per cubic meter per hour) were generally low (<3) for the unfractionated plankton. For the size-fractionated samples, the two larger fractions were most often low, and the <10-μm fraction had numbers >3 on 44% of the sampling dates.

53668 (CONF-771114—, pp 381-391) **Primary productivity: analysis of variance in a thermally enriched aquatic system.** Welch, M.O.; Ward, C.H. (Rice Univ., Houston, TX). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

Primary production experiments were performed in a 400-ha cooling reservoir for a 530-MW electric generating plant in eastern Texas over a 15-month period. Annual primary productivity of the heated and ambient surface waters and the nutrient enrichment response was investigated in situ by ^{14}C methods. On the basis of analysis of variance techniques, primary productivity was significantly higher at the heated station on 18 of 26 sampling dates, but the magnitude of the difference was not correlated with the difference in water temperature at the stations. Nutrient enrichment had no effect on primary productivity, but temperature did. Regression analysis indicated that the temperature optimum for the natural population of phytoplankton was ~ 25°C. The temperature tolerance range for the phytoplankton community subjected to higher temperatures was higher than for the community at ambient temperatures.

53669 (CONF-771114—, pp 392-409) **Nitrate reductase activity and primary productivity of phytoplankton entrained through a nuclear power station on northeastern Long Island Sound.** Peck, B.B.; Warren, R.S. (Connecticut Coll., New London). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

The effects of temperature and various concentrations of chlorine on nitrate reductase activity and primary productivity of phytoplankton were studied at the Millstone Nuclear Power Station on northeastern Long Island Sound. During August the ambient temperature at the cooling water intake ranged from 19.5 to 20°C. Power generation during this period resulted in temperature increases of 11 and 14°C at the discharge and depressed phytoplanktonic nitrate reductase activity by 88 to 89% and phytoplanktonic primary productivity by 42 to 52%. The decrease occurred during the 6- to 9-hr transit through the cooling pond. Nitrate reductase activity, maximally depressed after exposure to a mean increase of 13°C above ambient temperature on seven days in August, did not recover to intake control levels after 24 hr of incubation at ambient intake temperature. In March and April, when the ambient temperature of Long Island Sound water was 4.3 to 9.9°C, phytoplanktonic nitrate reductase activity was stimulated 25% above that of controls after 6 to 9 hr of exposure at 11.5 to 18.1°C above ambient temperature. The productivity results are similar to previous unpublished findings on temperature influence at this site. The nitrate reductase activity findings support the hypothesis that nitrate reductase is a heat-labile enzyme. Chlorine concentrations below and above those required to eliminate fouling organisms (0.50 ppM) produced large decreases in the photosynthetic rate of entrained phytoplankton. Previous work at this site reported similar findings. Nitrate reductase activity decreased 15% at 1.0 ppM and 1.2 ppM, the two highest chlorine dosages applied.

53670 (CONF-771114—, pp 410-419) **Growth of duckweed under constant and variable temperatures.** Sharitz, R.R.; Luvall, J.C. (Savannah River Ecology Lab., Aiken, SC). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

Effects of variable temperatures on the growth and vegetative reproduction of an aquatic plant were examined by exposing populations of Spirodela oligorrhiza to cyclic, acyclic, and constant temperature regimes. Growth rates under the cyclic and acyclic regimes (each of which ranged from 10 to 25°C) were not significantly different from those at a constant temperature equal to the mean of the range (17.5°C). Population growth was directly related to temperature in both constant and variable thermal regimes.

53671 (CONF-771114—, pp 420-433) **Growth and ecology of Spartina alterniflora in Maine after a reduction in thermal stress.** Keser, M.; Larson, B.R.; Vadas, R.L.; McCarthy, W. (Univ. of Maine, Orono). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

When a surface thermal discharge was relocated through a diffuser system in May 1975, the thermal impact on a previously stressed and moribund population of Spartina alterniflora in Montsweag Bay, Maine, was terminated. Post-stress growth and recovery were examined over three growing seasons. Plant biomass and density were lowest in 1975 because of continued surface discharge into Bailey Cove during the winter and early growing season of 1975. In 1976 and 1977, however, biomass and density increased slightly and shoot growth returned to prestress levels, as indicated by size-frequency distributions. The partial recovery of Spartina resulted from viable patches of plants and rhizomes in ~ 40% of the study area. In relation to previous values, biomass declined in the control marsh during this 3-year period. The decline was attributed to increased salinity, greater tidal amplitude, and decreased summer temperatures resulting from the removal of a causeway between the mainland and Westport Island in the fall of 1974.

53672 (CONF-771114—, pp 434-451) **Effects of reduced temperatures on previously stressed populations of an intertidal alga.** Vadas, R.L.; Keser, M.; Larson, B. (Univ. of Maine, Orono). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

Relocation of a surface thermal discharge through a multiport diffuser and removal of a causeway substantially reduced temperatures in an estuary surrounding a nuclear power plant. Although stressed and moribund during thermal discharge, basal portions of adult thalli of Ascophyllum nodosum showed considerable resilience to thermal stress and potential competition from other species and survived. Previously stressed populations recovered fully; all measures of vigor being indistinguishable from prestress years. Growth in apical tips was sensitive to small shifts in ambient water temperature, suggesting that Ascophyllum might be a good indicator for thermal and perhaps other stresses in marine ecosystems. Growth data indicate that thermal enhancement occurs in Ascophyllum, artificially from thermal effluent and naturally from increased insolation to newly exposed mud flats.

53673 (CONF-771114—, pp 452-469) **Genetic and physiological flexibility of a calanoid copepod in thermal stress.** Bradley, B.P. (Univ. of Maryland, Catonsville). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

The copepod Eurytemora affinis has considerable potential for both physiological and genetic adaptation to temperature stress. Physiological variance was expressed more in females, and genetic variance was expressed more in males. Estimates of both variances were obtained by several methods, all giving essentially the same results. The assay used to measure temperature tolerance depended on time to enter a coma after a temperature shock. Information was obtained on individuals that could later be used for breeding or retested. The assay was short term (30 min maximum) but was closely related to long-term survival in high temperatures. On the basis of field observations and laboratory experiments in cycling temperatures, the copepod populations seem to be at or near their limit of survival in summer temperatures in the Chesapeake Bay. This raises the question of whether all the genetic and physiological flexibility observed is usable in further adaptation or whether reproductive capacity, for example, becomes limiting.

53674 (CONF-771114—, pp 470-483) **Effects of thermal effluents on reproduction in a sea anemone.** Jennison, B.L. (Univ. of California, Berkeley). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

Reproduction of the sea anemone Anthopleura elegantissima was studied in the thermal-outfall canal of a large (1350-MW) Pacific Gas and Electric Company power plant and at an adjacent control site at Morro Bay, San Luis Obispo County, California. Female reproductive cycles, determined by oocyte diameters, were similar at both sites for 3 years; oocytes appeared in the fall, and spawning occurred in the late summer. Outfall females spawned as much as 1 month before control females, however. Spermatogenesis of outfall males was delayed and compressed compared with control populations, but outfall males developed quickly and spawned before control males. Anemones transplanted from the control to the outfall in November 1975 spawned by the end of March 1976; undisturbed animals from both sites did not spawn until the end of the summer. It is suggested that this species of sea anemone spawns during the summer period of highest annual temperature and that anemones in the outfall have become acclimated to the temperatures there, which are often 10°C above ambient.

53675 (CONF-771114—, pp 484-497) **Comparison of morphometric, biochemical, and physiological indexes of condition in marine bivalve molluscs.** Mann, R. (Woods Hole Oceanographic Institution, MA). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

A number of morphometric, biochemical and physiological parameters are compared and evaluated for their potential use as

indexes of condition in marine bivalve molluscs. Condition is defined as the ability of an animal to withstand an adverse environmental stress, be this physical, chemical, or biological. Laboratory and field data are compared to determine the effect of one environmental stressor, temperature, on gravimetric and volumetric meat/shell condition indexes; percentages of organic content, carbohydrate, carbon, and nitrogen; C/N and carbohydrate/N ratios; weight-specific ammonia excretion rates; and oxygen-consumption/ammonia-excretion ratios in a number of commercially valuable species of oyster, clam, and mussel.

53676 (CONF-771114—, pp 498-510) **Response of mosquitofish to thermal effluent.** Bennett, D.H.; Goodyear, C.P. (Savannah River Ecology Lab., Aiken, SC). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

Reproductive activity, sex ratios, size at sexual maturity, percentage of fat, and size structure were examined in five populations of mosquitofish (Gambusia affinis) from lentic environments experiencing different thermal conditions at the Savannah River Plant near Aiken, SC. Populations were sampled during February, June, October, and December 1970. Mosquitofish from three thermally affected stations inhabited waters from 28 to 40°C, whereas mosquitofish at the unaffected stations were found in waters from 12 to 29°C. Periods of reproductive activity were different for thermally affected and unaffected populations. Females with eyed embryos were found in mosquitofish populations from unaffected waters in June; eyed embryos were found in the affected populations throughout the study period. Mean brood size of populations from thermally affected areas generally varied inversely with water temperature. Size at sexual maturity and sex ratios were generally similar in the five populations. Body fat content varied seasonally for each population. Percentages of fat were significantly higher in male and juvenile fish from thermally affected waters than in those from unaffected waters, whereas fat content was similar in females. Mean size of females from unaffected waters was directly related to water temperature, whereas the size structure of mosquitofish populations from affected waters varied inversely with water temperature. This study indicates that G. affinis is a eurythermal species that can adapt to conditions of severe thermal stress.

53677 (CONF-771114—, pp 511-521) **Response of a mobile invertebrate to heterothermal conditions.** Lozano, S.J.; Kitchell, J.F. (Univ. of Wisconsin, Madison). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

Distribution and abundance of Hyalella azteca, a freshwater amphipod, were studied to determine responses to temperature of an organism that spends its entire life cycle in a spatially heterothermal system. The study site, a 190-ha power-plant cooling lake, has a stable 15°C horizontal temperature gradient throughout the year. Seasonal temperatures range from 4°C at the cool end of the lake in winter to 45°C at the warm end in summer. High water temperatures restricted the distribution and abundance of H. azteca. At other seasons, lower temperatures allowed wider distribution of amphipods in the lake. Reproduction and growth were also influenced by the temporal and spatial heterothermal conditions. Reproduction occurred only during short time intervals in spring and fall and differed from the continuous summer reproduction evident in surrounding waters. Field data on distribution, reproduction, and growth, plus laboratory studies, show evidence for a modified life history and temperature-directed movement in H. azteca.

53678 (CONF-771114—, pp 522-533) **Temperature selection by young topsmelt: laboratory and field investigations.** Ehrlich, K.F.; McGowen, G.E.; Muszynski, G. (Occidental Coll., Los Angeles, CA). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

Topsmelt (Atherinops affinis) were reared from eggs for 6.5 months. Their laboratory preferred-temperature range throughout this period (3 to 198 days post-hatching) was 19 to 23°C, and they avoided water temperatures warmer than 27°C. Selected temperatures were independent of acclimation temperatures, which were 10 to 21°C. Temperature did not act as a strong directing force for these fish (which have a wide thermal preference) until their lethal temperature was approached. Their behavior resulted in a frequency distribution significantly skewed toward the lower temperatures. Our ichthyoplankton survey found that the peak occurrence of young atherines was associated with their laboratory-determined preferred-temperature range.

53679 (CONF-771114—, pp 534-545) **Movement of three species of fishes past a thermally influenced area in the Coosa River, Alabama.** Moss, J.L.; Boonyaratpalin, S.; Shelton, W.L. (Auburn Univ., AL). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

Movement of ultrasonic-tagged largemouth bass and flathead and channel catfish passing the thermally influenced area of the Coosa River, Alabama, adjacent to the Ernest C. Gaston Steam Plant was studied during the warm part of the year. The area of thermal influence changed with the seasons, and movement of largemouth bass and catfish past the thermal zone was affected but was not prevented. Movement patterns suggested that the fishes avoided passing directly through the area of maximum temperature influence by traveling under or around it; thus the heated water did not form an impassable barrier.

53680 (CONF-771114—, pp 546-568) **Effects of thermal effluent on benthic marine invertebrates determined from long-term simulation studies.** Ford, R.F.; Foreman, D.G.; Grubbs, K.J.; Kroll, C.D.; Watts, D.G. (San Diego State Univ., CA). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

Laboratory experiments of 14-weeks duration were conducted to determine the effects of simulated thermal-effluent regimes on survival, growth, and body condition of seven motile invertebrate species from shallow, rocky habitats. Treatment conditions reproduced dynamic temperature regimes measured in the thermal plume of a large generating station in southern California 84 and 355 m from the discharge structure. Cam patterns of field-temperature records were used with time-cycle controllers and pneumatic mixing valves supplied with effluent and ambient-source water to control temperatures in groups of replicate 1100-l tanks. High survival and normal growth and condition of control animals indicated that laboratory conditions were satisfactory. Two sea urchin species (Strongylocentrotus purpuratus and S. franciscanus) exhibited relatively low survival and impaired growth and condition in the warmer effluent regime, the effects being most pronounced among large adults. Growth and condition of two asteroid starfish species (Pisaster ochraceus and P. giganteus) were adversely affected by both effluent regimes. Two species of gastropod molluscs (Kelletia kelletii and Roperia poulsoni), both warm—temperate forms, were relatively unaffected by either of the effluent regimes. Their survival, growth, and condition were not significantly different from controls in most cases. Growth and condition of a third gastropod (Astraea undosa) were adversely affected by effluent conditions, but survival was not.

53681 (CONF-771114—, pp 569-579) **Effects of thermal alteration on macroinvertebrate fauna in three artificial channels.** Alston, D.E.; Lawrence, J.M.; Bayne, D.R.; Campbell, F.F. (Auburn Univ., AL). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

Three earthen channels constructed at the Greene County Steam-Electric Generating Plant in Alabama were used in a 2-year study to evaluate the effects of heated effluents on aquatic biota. Macroinvertebrates were collectd with modified Hester—Dendy multiple-plate samplers and an Ekman dredge at 4- to 6-week intervals throughout the period. Channel 1, a control habitat, received unheated river water; channel 2, a thermally stratified habitat, received both unheated water and heated effluent waters from the steam plant; and channel 3 received only heated water. The highest average weekly water temperature in channel 1 was 30.8°C and in channel 3, 35.5°C. During most periods oligochaetes and chironomid larvae (Diptera) were the dominant organisms found in both plate and dredge samples. Total fish-food organisms collected from plate and dredge samples were in channel 1, 132,000, and in channels 2 and 3, 160,000. The overall mean diversities for dredge samples indicated that channels 1 and 2 were not significantly different, but channel 3 had a lower diversity. The plate samplers indicated that channel 1 had the highest diversity; channel 2, intermediate; and channel 3, lowest. Channels 1 and 2 had more mayflies (Ephemeroptera) than did channel 3.

53682 (CONF-771114—, pp 580-596) **Effects of power-plant operation on the littoral benthos of Belews Lake, North Carolina.** Lenat, D.R. (Univ. of North Carolina, Chapel Hill). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

The littoral benthos of Belews Lake in North Carolina, a 1500-ha cooling reservoir for a 2200-MW coal-fired power plant, were studied over a 3-year period, one preoperational year and two postoperational years. Comparing control areas with heated areas allowed separation of normal successional changes from changes associated with power-plant operation. Twenty-four taxa were analyzed in detail, and ten taxa appeared to be directly or indirectly affected by power-plant operation. The densities of Polypedilum digitifer, Nais communis, and Hyalella azteca decreased with increases in temperature. Densities of two other taxa, Hexagenia munda and Limnodrilus hoffmeisteri, increased with slight increases in temperature but decreased after further increases. Six other taxa appeared to have been indirectly affected by power-plant operation through changes in littoral macrophytes, periphyton, and other factors. Use of percent similarity coefficients showed that the impo-

sition of a thermal gradient resulted in a corresponding biological gradient.

53683 (CONF-771114—, pp 597-617) **Effects of power-plant operation on the phytoplankton community of Belews Lake, North Carolina.** Campbell, P.H. (Univ. of North Carolina, Chapel Hill). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

The phytoplankton community of Belews Lake, North Carolina, a 1500-ha cooling reservoir, was studied over a 4-year period. Two preoperational years served as a base line for 2 years of operation by the Belews Creek Steam Station, a 2200-MW coal-fired power plant. Circulation of surface waters by the power plant resulted in greater seasonal and spatial homogeneity of total standing-crop values and of distribution of dominant phytoplankton classes and taxa. No major changes in standing crop were found, but general successional changes in the phytoplankton community appeared to be accelerated after power-plant operation. Chlorophyceae dominance, measured by cell density, and Dinophyceae dominance, measured by biovolume, increased, but Bacillariophyceae dominance greatly decreased. Density and biovolume levels of all three classes exhibited no marked changes. No negative thermal influence on phytoplankton populations was found. No selection was observed for blue-green algae by the elevated temperatures of the thermal plume. Mean total cell densities and total biovolumes, numbers of taxa, and Shannon—Weaver diversity indexes exhibited steady increases. The values of these parameters all remained within ranges indicative of an oligomesotrophic lake.

53684 (CONF-771114—, pp 618-641) **Effects of power-plant operation on the zooplankton community of Belews Lake, North Carolina.** Anderson, T.P.; Lenat, D.R. (Univ. of North Carolina, Chapel Hill). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

The euphotic-zone zooplankton community of Belews Lake, North Carolina, was studied over a 3-year period. Belews Lake is a 1500-ha cooling reservoir for a 2200-MW coal-fired power plant. This study included 1 year of preoperational data and 2 years of postoperational data. A detailed examination of 19 taxa showed that three species may have responded to power-plant operation. Two warm stenotherms (Hexarthra and Ptygura) increased in density, and an increase in the winter density of Polyarthra was also noted. An analysis of variance indicated that circulation of surface water by the power plant resulted in greater spatial and seasonal homogeneity for most taxa. Other changes in the zooplankton community appeared related to natural causes.

53685 (CONF-771114—, pp 642-662) **Stochastic approach to predict survival of estuarine animals exposed to hot discharge effluent.** Chung, K.S.; Strawn, K. (Texas A and M Univ., College Station). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

The stochastic model was used to predict survival probabilities for aquatic animals in intake water exposed to hot discharge effluent for 180 min (30 min afferent and 150 min efferent to the cooling towers) on the basis of water-passage times. The least-squares method was used to estimate seasonal mortality rates of 8 species of crustaceans and 46 fishes at several test temperatures for each of three seasons. During the hot season (June—September), mortality rates (fraction/min) were 23% or greater for most organisms at 40°C (discharge-canal temperature afferent to the cooling towers) and zero for most animals at 35°C (discharge temperature efferent to the towers). Survival probabilities for macrocrustaceans and fishes after a 180-min passage through the discharge-canal system, in terms of average seasonal temperature, ranged from 0 to 96% from June—September and from 0 to 61% for the 56 species tested. Almost all mortality occurred during the 30-min passage before the cooling towers. From October—May, predicted survival for all animals except the bay anchovy was 100% after a 180-min passage through the discharge-canal system (survival for the anchovy was 88% in the cool season, May and October).

53686 (CONF-771114—, pp 663-690) **Pathogenic species of thermophilic and thermotolerant fungi in reactor effluents of the Savannah River Plant.** Tansey, M.R. (Indiana Univ., Bloomington); Fliermans, C.B. Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

The growth, occurrence, and distribution of thermophilic and thermotolerant fungi were studied in effluents from Savannah River Plant nuclear reactors. Samples of foam, water, microbial mats, plant debris, air, and soils from sites of elevated and ambient temperatures were analyzed by direct microscopic examination and by quantitative plating. Analyses revealed that, except for Dactylaria gallopava, populations of thermotolerant and thermophilic fungi were not significantly different at elevated and ambient temperature sites. Dactylaria gallopava, a thermotolerant fungus that causes epidemic encephalitis in poultry, is abundant in the microbial mats, in foam, and in soils at the edges of the cooling-water effluents. It is directly associated with effluents that have temperatures of 44°C and higher. The evidence suggests that the thermal effluents are responsible for the occurrence of D. gallopava.

53687 (CONF-771114—, pp 691-702) **Responses of the alligator to infection and thermal stress.** Glassman, A.B.; Bennett, C.E. (Medical Univ. of South Carolina, Charleston). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

The effects of infection by Aeromonas hydrophila in Alligator mississippiensis are reported. Peripheral blood components and serum protein electrophoretic patterns in normal vs infected and/or thermally stressed animals are described. Alligators respond to bacterial infection with an increase in white blood cells of the neutrophilic macrophage types. Leech infestations are associated with an increase in eosinophils. Treatment of animals, either with a topical antibiotic ointment or intramuscular injections of an appropriate antibiotic, results in healing of lesions and return of the white blood cell counts to normal levels. Removal of leeches leads to a decrease in eosinophilic counts. Serum protein electrophoretic changes accompanying infection include an increase in total protein and in the gamma and alpha 2 fractions. As alligators age total protein increases, primarily from an increase in the gamma region.

53688 (CONF-771114—, pp 703-713) **Acclimation states of juvenile striped bass held in constant and fluctuating temperature regimes.** Cox, D.K. (Oak Ridge National Lab., TN). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

Sinusoidal temperature fluctuations of varying periodicities caused juvenile striped bass, Morone saxatilis, to have acclimation states higher than the constant average temperatures but lower than the maximum temperatures of the cycles, on the basis of determinations of critical thermal maximums. More rapid cycling caused higher acclimation states. There were no effects of time of day or illumination. Heat tolerance of fish from thermally fluctuating environments will likely be underestimated if average environmental temperatures are assumed to represent the acclimation state. Also, tolerance data developed at constant acclimation temperatures will underestimate survival in fluctuating temperature regimes.

53689 (CONF-771114—, pp 714-725) **Effects of acute and chronic thermal exposures on the eggs of three Hudson River anadromous fishes.** Kellogg, R.L.; Salerno, J.J.; Latimer, D.L. (Ecological Analysts, Inc., Middletown, NY). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

Atlantic tomcod, alewife, and striped bass eggs were tested for chronic and acute tolerance to elevated temperatures to generate information on potential thermal effects of power-plant operation. Upper lethal temperatures (TL_{50}) for normal hatching success were 26.5°C for alewife eggs, 26.3°C for striped bass eggs, and 6.6°C for Atlantic tomcod eggs. Thermal tolerance of eggs exposed to elevated temperatures for 5 to 60 min increased with advancing stage of embryonic development and decreased with lengthening exposure duration. The applications of the data to the assessment of the impact of power plants are discussed.

53690 (CONF-771114—, pp 726-747) **Multiple-factor and synergistic stresses in aquatic systems.** Vernberg, F.J. (Univ. of South Carolina, Columbia). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

Most studies on the adaptation of aquatic systems to environmental fluctuations have dealt with the responses of an organism to variation in a single factor, while other factors are kept constant and usually at optimal levels. This is a logical approach and has resulted in a good understanding of response mechanisms of the whole organism, tissues, and cellular components. However, organisms typically are exposed to a complex of factors, with two or more factors varying at the same time. The question is, how does the complex machinery of either an organism or a multiorganismic system deal with complex environmental fluctuations. To understand the ability of a biological system to survive in its ecological setting, we must direct our attetion to an analysis of multiple factor effects and interactions both under laboratory conditions and in the field. To be ecologically significant, experiments must be designed to simulate conditions of the system's real world. Unfortunately this is difficult to achieve because, for example, (1) detailed analyses of the microenvironmental conditions experienced by organisms or systems are, with few exceptions, lacking, and (2) simultaneous variation in several distinct factors is both technically difficult and expensive to achieve in the laboratory. Field studies are difficult because of the complexity of biological systems, the lack of undisturbed areas for long-term study, and the need for a multidisciplinary team of researchers. Fortunately some advances have been made with the help

of the sophisticated statistical and computer techniques required to analyze the resultant complex data.

53691 (CONF-771114—, pp 748-770) **Ordination of macroinvertebrate communities in a multistressed river system.** Beckett, D.C. (Univ. of Cincinnati, OH). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

The macroinvertebrate communities of the Great Miami River system (southwestern Ohio) were studied over a wide range of environmental conditions and stresses. Stations ranged from relatively undisturbed locations to areas subjected to flood-control modification, power-plant thermal discharges, municipal sewage-treatment-plant discharges and industrial-wastewater outfalls. Similarity indices and subsequent polar ordination showed that river passage through the city of Dayton did not prohibit high biotic similarity between some sites below Dayton and undisturbed upstream locations. Stations showed varying patterns of affiliation (based on similarity indices), which correlated well with changes in river discharge. Two types of faunal homogeneity were apparent: during relatively high river-discharge periods a high degree of faunal similarity occurred between far upstream and far downstream stations, and during low flow conditions a biotic homogeneity was evident among all downstream stations as a result of the maximization of pollutional influences and the subsequent domination of euryecious species. Ordination of stations during high flow conditions did not produce an ordering along any gradients. During low flow conditions, however, stations ordered well along a gradient of pollutional disturbances. Pollutional effects seemed to overwhelm the effect of normal environmental variables on faunal composition during these low flow conditions.

53692 (CONF-771114—, pp 771-784) **Longitudinal variation in the macroinvertebrate fauna and water chemistry of an eastern Pennsylvania trout stream.** Bradt, P.T. (Lehigh Univ., Bethlehem, PA). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

Chemical and biological parameters in Bushkill Creek, Northampton County, Pennsylvania, were sampled for 17 months to evaluate the benthic macroinvertebrate population and to estimate the future of the stream as habitat for reproducing brown trout. Continuing development in the drainage basin has placed increasing stress on the stream. Longitudinal zonation was noted both in the macroinvertebrate fauna and in the water chemistry. Total alkalinity, pH, conductivity, nitrate, chloride, and total iron increased downstream. Biomass, total numbers, and number of taxa of benthic macroinvertebrates peaked at a station 10 km above the mouth, then decreased at the downstream station that was located in an urban area. Diversity was highest at the rural upstream station and decreased downstream. Dominant taxa of macroinvertebrates changed from Stenonema (Ephemeroptera) at the upstream station, to Hydropsyche (Trichoptera) at the two midstream stations, and to Chironomidae (Diptera) at the downstream station. Hydropsyche and the Chironomidae are tolerant of a wide range of environmental conditions. If the stream is to continue to support a reproducing brown trout population in the lower reaches, the stresses on the stream from urbanization must be minimized.

53693 (CONF-771114—, pp 785-793) **Effect of ionizing radiation on the thermal tolerance of mosquitofish.** Blaylock, B.G.; Frank, M.L. (Oak Ridge National Lab., TN). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

This study determined the effects of acute ionizing radiation on the thermal tolerance of the mosquitofish, Gambusia affinis. Gambusia of approximately the same size were given doses of radiation ranging from 500 to 5000 rads from a ^{60}Co source. The irradiated fish were tested 5, 15, and 30 days after irradiation for either lethal temperature with a critical thermal maximum (CTM) type test or mean survival time in a lethal temperature bath (39.5°C). The lethal temperature for Gambusia irradiated with 500 rads was not significantly different from that of control fish; neither were lethal temperatures for fish irradiated with 1500 rads and tested at 5 and 30 days after irradiation. At day 15 and 1500 rads, however, lethal temperature was significantly reduced. At a dose of 1500 rads, histopathological effects were observed in the hematopoietic tissues of Gambusia 5 days after irradiation; regeneration of the tissue began by day 15 and continued through day 30. The mean survival time of Gambusia was not affected by a dose of 500 rads; but, at doses of 1500 rads and above, the effect was significantly different at day 5. A significant difference was also detected at day 15 for the fish receiving a 1500-rad dose. Recovery had taken place by day 30, however, and the mean survival times were not significantly different from controls.

53694 (CONF-771114—, pp 794-808) **Response of ichthyoplankton to stresses simulating passage through a power-plant condenser tube.** Poje, G.V.; Ginn, T.C.; O'Connor, J.M. (New York Univ. Medical Center, Tuxedo). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

A power-plant condenser-tube simulator that can subject entrainable organisms to temperature changes, pressure and flow variation, biocides, and fluid-induced stresses similar to those at existing power-plant condenser tubes was designed and constructed. Larvae of carp (Cyprinus carpio) and striped bass (Morone saxatilis) were exposed for 5 min total duration to a range of entrainment stresses in three experimental designs: (1) Temperature was varied while a flow velocity of 1.22 m/sec and a minimum pressure of 0.51 atm was maintained; (2) flow was varied, and a constant, sublethal temperature increase ($\Delta T = 0$ and 8.2°C for bass or 16.7°C for carp) was maintained; and (3) biocide concentrations (sodium hypochlorite) were varied at constant velocity (1.22 m/sec) and ΔT (0 and 8.3°C or 11.1°C). Carp larvae had significantly higher latent mortalities at 18.1°C ΔT (36.1°C final temperature), and striped bass were most sensitive at 15.5°C ΔT (33.6°C). A complicated survival pattern developed because of the combined stresses.

53695 (CONF-771114—, pp 809-825) **Effects of simulated entrainment on the biology of a freshwater cladoceran.** Buikema, A.L. Jr.; Sherberger, S.R.; Knauer, G.W.; Newbern, L.A.; Reading, J.T.; Cairns, J. Jr. (Virginia Polytechnic Inst. and State Univ., Blacksburg). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

Under simulated entrainment conditions Daphnia pulex were exposed separately and in combination to temperature (10 and 14°C above 20°C ambient), chlorine (0.35 to 0.50 ppM), and mechanical stress (4 liters/min through a 12.5-mm tube). In a 12-min period, maximum exposure occurred for less than 2 min, followed by dilution and/or cooling. After exposure the animals were monitored for mortality, adenosine triphosphate (ATP), metabolism, feeding, growth, molting, reproduction, and behavior. Chlorine and combined stress significantly reduced the levels of ATP. A 14°C stress significantly depressed metabolism. Mechanical stress significantly increased metabolism, and the combined stress had no significant effect on metabolism. Stresses of 10 and 14°C caused a decrease in feeding. Mechanical stress accounted for 30 to 80% acute mortality. Survivors of stress were observed for latent effects. Chlorine reduced growth rates. No significant effects on reproduction were observed when the animals were fed high-quality food. Poor food quality caused a significant reduction in the number and vitality of young produced by females exposed to 10°C stress or to combined stress. There were no significant effects of entrainment on molting, behavior, or long-term survival.

53696 (CONF-771114—, pp 826-837) **Avoidance response of the common shiner to total and combined residual chlorine in thermally influenced discharges.** Cherry, D.S.; Larrick, S.R.; Giattina, J.D.; Dickson, K.L.; Cairns, J. Jr. (Virginia Polytechnic Inst. and State Univ., Blacksburg). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

Chlorine avoidances of the common shiner [Notropis cornutus (Mitchell)] were determined in a trough containing a steep horizontal gradient. Responses were evaluated by treating New River water with doubling increments of total residual chlorine (TRC) from 0.025 to 0.40 mg/l. Free residual chlorine (FRC) was measured; combined residual chlorine (CRC) and the hypochlorous acid content (HOCl) were calculated; and each of the fractions comprising the TRC was correlated with fish behavior. Tests were carried out at acclimation temperatures of 12, 18, 24, and 30°C for the unheated TRC treatments and at 12 and 24°C for all other tests. The first significant or threshold avoidance to TRC (represented by a significant decrease in residence time in treated vs untreated water) occurred at levels varying from 0.10 to 0.20 mg/l, depending on the acclimation temperature tested. The CRC and FRC comprising the TRC at the threshold avoidance level varied from 0.077 to 0.159 and 0.035 to 0.122 mg/l, respectively. Variation in threshold avoidance concentrations for fractions within the TRC was lowest for HOCl, 0.010 to 0.028 mg/l. In chloramine trials conducted at 12 and 24°C, avoidances first occurred at 0.207 and 0.205 mg/l, respectively. When fish were acclimated at 12 and 24°C and tested in preferred temperatures for these acclimation temperatures (17.6 and 26.8°C, respectively), TRC threshold avoidances occurred at 0.211 and 0.209 mg/l. Chloramine avoidance thresholds were 0.399 mg/l at 12°C and 0.195 mg/l at 24°C. Avoidance of ammonia was not a factor in the chloramine tests since the fish did not avoid ammonia nitrogen concentrations of 0.015 to 0.275 mg/l in separate tests. The avoidance responses to chlorine in ambient and preferred temperature conditions suggest that the common shiner was less influenced by the presence of chloramine and was more sensitive to a low threshold concentration of HOCl in TRC treatments.

53697 (DP-MS—78-94) **Computer modeling of ground-water flow at the Savannah River Plant.** Root, R.W. Jr. (Du Pont de Nemours

(E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1979. Contract EY-76-C-09-0001. 36p. (CONF-790497—1). P 03/MF A01.

From 27. annual meeting of the southeastern section of the Geological Society of America; Blacksburg, VA, USA (26 Apr 1979).

Mathematical equations describing ground-water flow are used in a computer model being developed to predict the space-time distribution of hydraulic head beneath a part of the Savannah River Plant site. These equations are solved by a three-dimensional finite-difference scheme. Preliminary calibration of the hydraulic head model has been completed and calculated results compare well with water-level changes observed in the field. 10 figures, 1 table.

53698 Distribution, composition, and transport of suspended particulate matter in the vicinity of Willapa submarine canyon, Washington. Baker, E.T. (Univ of Washington, Seattle). *Geol. Soc. Am., Bull.;* **87**: 625-632(Apr 1976).

The distribution and composition of suspended particulate matter in the waters over Willapa submarine canyon and the adjacent continental slope off the coast of Wasington describe an apparently continuous botton nepheloid layer ranging in thickness from 160 to 530 m and composed of particles supplied primarily by the nearby Columbia River. Near-bottom particulate concentrations, estimated by continuous vertical profiles of light-scattering intensity, systematically decrease from the continental shelf to the base of the slope. Within this trend, concentrations in Willapa Canyon are greater by a factor of as much as 3 than concentrations present at comparable locations on the adjacent open-slope areas. Mineralogical analysis of the suspended sediment within the bottom nepheloid layer suggests that the increased concentrations found within Willapa Canyon result from a preferential accumulation of Columbia River-derived particles relative to the surrounding open-slope areas. Montmorillonite/chlorite ratios >1 characterize the Columbia River suspended load, and this ratio remains >0.7 in samples from upper Willapa Canyon while decreasing to <0.7 in samples from the surrounding open slope and lower Willapa Canyon. Chemical homogeneity of the suspended particulates from the Columbia River to the base of the slope is indicated by the nearly constant ratios of the major-element oxides to Al_2O_3. The excess density provided by the intense nepheloid layer found in Willapa Canyon may be influential in generating a net downcanyon component of bottom flow such as observed in other submarine canyons. Predicted rates of net basinward transport of the bottom nepheloid layer sediments range from 2.8 cm sec^{-1} at 635 m to 1.5 cm sec^{-1} at 1,500 m, values that are in good agreement with long-term current measurement in other canyons.

RADIOMETRIC TECHNIQUES

REFER ALSO TO CITATION(S) 53693

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 52512, 52559, 53272, 53627, 53636, 53641, 53642, 53643, 53645, 53646, 53647, 53653, 53655, 53656, 53739

53699 (CONF-7806143—, pp 209-227) **Estimate of the source of a phreatic aquifer pollution by hydrocarbons: oil—water contact and transfer of soluble substances in groundwater.** Zilliox, L.; Muntzer, P.; Fried, J.J. (CNRS, Strasbourg, France). 1978.

From International symposium on ground water pollution; Prague, Czechoslovakia (Jun 1978).

Infiltration of hydrocarbons from the ground surface to the water table and the mechanisms of transfer were studied. Velocities of infiltration of various hydrocarbon fractions in wet and dry soils were investigated. The effect of a well on a layer of petroleum products at the water table level was evaluated. Various compositions of gas—oil, toluene, and isooctane were used to examine exchanges between oil products and groundwater. (JGB)

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 53272, 53641, 53642, 53643, 53645, 53646, 53647, 53653

WATER

REFER ALSO TO CITATION(S) 52683, 52705, 53652

AQUATIC ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 53477, 53650

53700 (EMSL-LV—0539-25) **Freshwater algae of the Nevada Test Site.** Taylor, W.D.; Giles, K.R. (Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab.). Jun 1979. Contract EY-76-A-08-0539. 26p. P 03/MF A01.

Fifty-two species of freshwater algae were identified in samples collected from the eight known natural springs of the Nevada Test Site. Although several species were widespread, 29 species were site specific. Diatoms provided the greatest variety of species at each spring. Three-fifths of all algal species encountered were diatoms. Well-developed mats of filamentous green algae (Chlorophyta) were common in many of the water tanks associated with the springs and accounted for most of the algal biomass. Major nutrients were adequate, if not abundant, in most spring waters - growth being limited primarily by light and physical habitat. There was some evidence of cesium-137 bioconcentration by algae at several of the springs.

THERMAL EFFLUENTS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 52883, 53658, 53660, 53667, 53668, 53669, 53670, 53671, 53672, 53673, 53674, 53675, 53676, 53677, 53678, 53679, 53680, 53681, 53682, 53683, 53684, 53685, 53686, 53687, 53688, 53689

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 52885, 52886, 52887, 53282, 53700

53701 (ORNL/TM—6375) **Spatial analysis method of assessing water supply and demand applied to energy development in the Ohio River Basin.** Shepherd, A.D. (Oak Ridge National Lab., TN (USA)). Aug 1979. Contract W-7405-ENG-26. 132p. P 07/MF A01.

The focus of the study is on water availability for energy development in the Ohio River Basin; however, the techniques developed are applicable to water supply investigations for other regions and uses. The study assesses the spatial association between water supply and demand for future energy development in the Basin. The problem is the development of a method that accurately portrays the actual spatial coincidence of water availability and use within a basin. The issues addressed involve questions of scale and methods used to create a model distribution of streamflow and to compare it with projected patterns of water requirements for energy production. The analysis procedure involves the compilation of streamflow data and calculation of 7-day/10-year low-flow estimates within the Basin. Low-flow probabilities are based on historical flows at gaging stations and are adjusted for the effects of reservoir augmentation. Once streamflow estimates have been determined at gaging stations, interpolation of these values is made between known data points to enable direct comparison with projected energy water-use data. Finally, a method is devised to compare the patterns of projected water requirements with the model distribution of streamflow, in sequential downstream order.

ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

SOCIAL AND ECONOMIC STUDIES

REFER ALSO TO CITATION(S) 53308

53702 (SERI/TP—52-058) **Economic measurement of energy related environmental damages. Workshop summary.** Yokell, M.D. (Solar Energy Research Inst., Golden, CO (USA)). Dec 1978. Contract EG-77-C-01-4042. 47p. P 03/MF A01.

The main objectives of this workshop were to point out the weaknesses in SERI's proposed method of quantifying the environmental benefits and costs of solar energy and to suggest improvements. Weaknesses were indeed highlighted, though only a few suggestions for improvement were provided. The weaknesses in the SERI project'S methodology are of three types, corresponding to the three generic steps required in the analysis: projection of residuals from solar energy scenarios, translation of these residuals into concentrations and exposures, and measurement of the economic damages associated with these exposures. Two main criticisms were levied against SEAS, the tool used for projecting the emissions consequences of solar energy scenarios. First, because the model is not probabilistic, it does not account for low-probability, high-

impact events such as those that might be associated with a nuclear accident. Thus it makes nuclear energy seem more environmentally benign than it is. Second, the model does not extend far enough into the future to capture the full environmental impacts of solar technologies. At least one participant recommended the use of a more highly aggregated, longer time-frame model.

ASSESSMENT OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 53362, 53408

53703 (BNL—50815) **Effect on air and water emissions of energy conservation in industry.** Raskin, P.D.; Rosen, R.A. (Energy Systems Research Group, Inc., Albany, NY (USA)). Jul 1977. Contract EY-76-C-02-0016. 74p. P 04/MF A01.

Environmental emissions for five large energy-consuming industries plus others are estimated for four US energy system scenarios for 1985 and 2000. Emissions are estimated by specifying fuel mixes to steam boilers and direct heat, combustion efficiencies, shifts in the relative shares of alternative industrial processes use of industrial cogenerators, and penetration of pollution-control technologies. Analyses show that emissions do not vary significantly among scenarios principally because of increased coal use and the reduced penetration rate of advanced pollution-control technologies in the low-energy-demand scenarios. Within scenarios, emissions from the chemical and iron and steel subsectors dominate all aggregate estimates. Hydrocarbon and carbon monoxide process emission coefficients for the chemical subsector must be improved.

ENVIRONMENTAL IMPACT STATEMENTS

REFER ALSO TO CITATION(S) 52558

BIOMEDICAL SCIENCES, BASIC STUDIES

BEHAVIORAL BIOLOGY

REFER ALSO TO CITATION(S) 53745

53704 **How operant conditioning can contribute to behavioral toxicology.** Laties, V.G. (Univ. of Rochester, NY). *Environ. Health Perspect.;* **26**: 29-35(Oct 1978).

Operant conditioning can contribute to the development of behavioral toxicology in many ways. Its techniques are useful in training animals in the various behaviors the toxicologist may wish to study. They make possible the sophisticated assessment of sensory functioning. Operant conditioners excel at using schedules of intermittent reinforcement to create the type of stable animal performance needed in studying substances that produce effects only after prolonged exposure. Schedule-controlled behavior also helps elucidate the precise behavioral mechanisms involved in toxicity. In the early assessment of toxic substances a judiciously chosen sample of schedule-controlled performances may provide the best estimate whether the integrity of complex operant behavior remains unchanged. The development of improved behavioral techniques and computer technology promises to bring down the cost of such assessment.

BIOCHEMISTRY

REFER ALSO TO CITATION(S) 53717, 53750

53705 **Size and number of replicon families of chromosomal DNA of Arabidopsis thaliana.** Van't Hof, J.; Kuniyuki, A.; Bjerknes, C.A. (Brookhaven National Lab., Upton, NY). *Chromosoma;* **68**: 269-285(1978).

Analysis of the replicon properties and the cell cycle of Arabidopsis thaliana (col.) at 22°C were performed via autoradiography of isolated chromosomal DNA fibers and single cells of seedlings. The cell cycle was 8.5 h and G1, S, and G2 + 1/2 M were 1.7, 2.8, and 4 h respectively. The average single fork rate was 5.8 μm/h and the average replicon size was 24 μm. The data best support the hypothesis that A. thaliana has two replicon families, one with approximately 687 and another with 1888 members per genome and that the families initiate replication in sequence separated by a 36 min interval. Replication of an average single replicon required a little more than 2 h or 74% of S and the 36 min interval between the initiation of replication by the two families constituted 21% of S.

53706 **Method for measuring phytochrome in plants grown in white light.** Jabben, M.; Deitzer, G.F. (Smithsonian Institution, Rockville, MD). *Photochem. Photobiol.;* **27**: 799-802(1978).

Quantitative spectrophotometric measurement of phytochrome in plants grown for relatively long periods of time in white light is not possible due to the presence of chlorophyll. A method is described that prevents the accumulation of chlorophyll permitting such direct spectrophotometric measurement in light-grown tissue. Oat seedlings grown in the presence of the herbicide San 9789 (Norflurazon) for 6 days in constant light have considerably less chlorophyll than etiolated seedlings exposed to 1 min of light. Phytochrome concentrations measured in vivo and in vitro in these herbicide-treated plants were found to be about 2% of the level in etiolated tissue.

53707 **Trytophan distribution in yeast hexokinase isoenzyme B.** Kramp, D.C.; Feldman, I. (Univ. of Rochester, NY). *Biochim. Biophys. Acta;* **537**: 406-416(1978).

Titrations of quenching of tryptophan fluorescence of yeast hexokinase isoenzyme B by Cs^+, I^- and glucose, singly and in various combinations, were performed at pH 5.5, 8.3, and 10.1 at 20°C. The iodide and glucose titrations at pH 8.3 indicated the four tryptophan residues of the monomer subunit can be classified as: (1) a highly accessible surface tryptophan (Trp-S_1); (2) a surface tryptophan (Trp-S_2) with restricted accessibility; (3) a glucose-quenchable cleft tryptophan (Trp-G); and (4) a buried tryptophan (Trp-B) in the hydrophobic interior. The Stern-Volmer constants, k/sub I/, for iodide quenching of the two surface residues at pH 8.3 are 22 and 3.3 M^{-1}. The k/sub I/ value of Trp-G at this pH is iodide dependent, increasing from 1.2 to 1.4 M^{-1} as the iodide concentration increases from 0.1 to 0.65 M, probably because of iodide-induced alteration of the cleft structure. An iodide concentration above 0.65 M quenches Trp-B detectably, demonstrating a large structural change in the isoenzyme. The 350 nm emission attributable to the individual tryptophan residues at pH 8.3 are 9, 22, 28, and 41%, for Trp-S_1, Trp-S_2, Trp-G, and Trp-B, respectively. These results agree qualitatively with results deduced from the wavelength dependence of glucose quenching. I^- and glucose bind non-competitively to produce a synergistic enhancement of quenching of the cleft tryptophan fluorescence. At pH 5.5 even a low iodide concentration causes some quenching of Trp-B, especially in presence of saturating glucose. At pH 10.1 glucose does not quench the tryptophan emission nor influence the iodide-quenching action. However, at this pH the k_i of Trp-S_1 is reduced to the point where it is not resolvable from the k/sub I/ values of Trp-S_2 and Trp-G, even though the sum of the fractional fluorescence contributions of these three residues is the same as at pH 8.3.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 53713

CYTOLOGY

REFER ALSO TO CITATION(S) 53706

53708 (LBL—9322) **Three-dimensional reconstruction in electron microscopy.** Grano, D.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1979. Contract W-7405-ENG-48. 395p. P 17/MF A01.

The development and implementation of a versatile system of image processing programs for electron microscopy is described. Both high-dose, negatively stained specimens and low-dose, unstained specimens can be analyzed by this system. The theory behind image analysis in electron microscopy is described together with the practical aspects of computer processing of electron micrographs. The Fourier transform of cylindrically symmetric objects is studied in some detail. The range of structural deductions that may be made from the Fourier transforms of projections of such objects is discussed. The methods of 2-D image filtering are applied to high-dose images of negatively stained gap junction membranes and to frozen, hydrated, low-dose images of the hexagonally packed protein component of Spirillum serpens cell wall. The computer processed Spirillum specimen reveals the presence of Y-linkers similar to those seen in negatively stained preparations. Computer processing of the gap junction images makes the presence of a central staining pit more obvious. The techniques of 3-D helical reconstruction are applied to high-dose images of negatively stained T4 bacteriophage tails, to demonstrate the successful transfer of the IBM-based MRC helical reconstruction programs to our Control Data corporation computer system. Finally, the tubular structures found in preparations of Spirillum serpens cell wall are analyzed by Fourier methods.

53709 Caffeine inhibition of prereplication repair of mitomycin C-induced DNA damage in human peripheral lymphocytes. Ishii, Y.; Bender, M.A. (Brookhaven National Lab., Upton, NY). *Mutat. Res.;* **51**: 419-425(1978).

Caffeine increases the number of sister-chromatid exchanges (SCE) induced by mitomycin C (MMC) in human peripheral lymphocytes in culture. This enhancement decreases when the treated cells are held in medium before phytohemagglutinin (PHA) stimulation, or when caffeine is added to cultures some time after PHA stimulation but prior to DNA synthesis. There thus appears to be a caffeine-sensitive prereplication repair system, presumably an excision mechanism, capable of repairing a fraction of the MMC-induced DNA lesions.

53710 Transfer of genetic information via isolated amphibian metaphase chromosomes. Rosenstein, B.S.; Ohlsson-Wilhelm, B.M. (Univ. of Rochester, NY). *Somatic Cell Genet.;* **4**: No. 3, 341-354(1978).

The metaphase chromosome transfer system of McBride and Ozer (1973) has been adapted to a haploid, euploid, frog cell line. Genes coding for a deoxypyrimidine kinase and an enzyme responsible for a thymidine-specific saturable transport system have each been transferred at frequencies between 10^{-6} and 10^{-5} transferants per cell treated. Revertants for each of these two genes were observed at frequencies between 10^{-8} and 10^{-7} revertants per cell tested. Selfing controls showed no transferents. Two colonies were obtained in which cotransfer of both genes may have occurred. Activities of the transferred genes were assayed by incorporation of [^{3}H]thymidine into alkali-stable, acid-precipitable material. Growth properties of 13 transferents in various media were also determined and presence of the appropriate enzymes inferred. These transferents were tested for stability early (25 generations) after transfer and were found to be stable. All 13 transferents possess the normal haploid number of chromosomes (n = 13) with no cytologically detectable chromosomal fragments.

53711 Factors influencing the frequency of mitomycin C-induced sister-chromatid exchanges in 5-bromodeoxyuridine-substituted human lymphocytes in culture. Ishii, Y.; Bender, M.A. (Brookhaven National Lab., Upton, NY). *Mutat. Res.;* **51**: 411-418(1978).

Newly developed techniques for the detection of sister-chromatid exchanges (SCE) require the substitution of 5-bromodeoxyuridine (BrdU) for thymidine in DNA. We investigated the possibility of interactions between BrdU and one mutagen—carcinogen, mitomycin C (MMC) for the induction of both chromosomal aberrations and SCE in human peripheral lymphocytes in culture. No effect on aberration yield was found. Neither comparisons between the yields of SCE by BrdU substitution and differential staining and those detected by tritiated thymidine incorporation and autoradiography nor between the yields of SCE for different levels of BrdU incorporation provided any evidence of synergism. It was found, however, that MMC persists in cultures and continues to increase SCE frequencies for about 30 h. It was also observed that some MMC-induced DNA lesions persist long enough so that some of those present prior to S phase of the first cell cycle cause additional SCE in the third cycle.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 53716

GENETICS

REFER ALSO TO CITATION(S) 53710

METABOLISM

REFER ALSO TO CITATION(S) 53727

53712 Natural $^{13}C/^{12}C$ ratio variations in human populations. Gaffney, J.S.; Irsa, A.P.; Friedman, L.; Slatkin, D.N. (Brookhaven National Lab., Upton, NY). *Biomed. Mass Spectrom.;* **5**: No. 8, 495-497(1978).

Baseline data on the naturally occurring $^{13}C/^{12}C$ ratios of human tissue samples from several modern human populations are presented. Isotope ratios were determined for endogenous tissue samples (brain, liver, and lung) from 20 routine unselected autopsy cases of residents of Long Island, New York. Comparable data were obtained from tissue samples from Bergen, Norway, and Lucerne, Switzerland. Average values of ^{13}C ratios reported in units of delta^{13}C (0/00) relative to the PDB carbonate standard were -20.6 +- 1.0 for 49 tissue samples from Switzerland, -20.7 +- 1.0 for 21 tissue samples from Bergen, Norway, and -16.2 +- 1.0 for 89 tissue samples from Long Island, New York. These variations are discussed in terms of the isotopic carbon inventory in the respective diets of the populations sampled and also in terms of their implications for biomedical investigation.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 53715

53713 (AD-A—062251) **Metabolism of hydrazine. Annual report, 17 January 1977-17 January 1978.** Dost, F.N.; Springer, D.L. (Oregon State Univ., Corvallis (USA). Dept. of Agricultural Chemistry). Sep 1978. Contract F33615-77-C-0500. 22p. Y A02/MF A01.

A closed, vacuum tight animal maintenance system has been devised that enables recovery of very small amounts of respiratory ^{15}N over extended periods. Animals with indwelling cannulas for injection and sampling are placed in a closed, circulating atmosphere of 75% SF_6/25% O_2. Carbon dioxide is removed in a soda lime trap, and O_2 is added by a peristaltic pump controlled by a pressure sensitive switch. At the time of collection, the animal is euthanized and the atmosphere is circulated through a pyrogallol trap to remove most of the oxygen, then transferred by temperature gradient to a high vacuum system where SF_6 is frozen out. Preliminary studies of the disposition of intact hydrazine and its derivatives in rats are described. Substantial amounts of a metabolite tentatively identified as diacetyl hydrazine were found in urine. During continuous infusion of hydrazine, some animals maintained a constant blood hydrazine level, others were unregulated and experienced a continuous increase for the duration of infusion.

MEDICINE

UNSEALED RADIONUCLIDES IN DIAGNOSTICS

53714 (LBL—7486) **Attenuated radon transform: theory and application in medicine and biology.** Gullberg, G.T. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1979. Contract W-7405-ENG-48. 280p. P 13/MF A01.

A detailed analysis is given of the properties of the attenuated Radon transform and of how increases in photon attenuation influence the numerical accuracy and computation efficiency of iterative and convolution algorithms used to determine its inversion. The practical applications for this work involve quantitative assessment of the distribution of injected radiopharmaceuticals and radionuclides in man and animals for basic physiological and biochemical studies as well as clinical studies in nuclear medicine. A mathematical structure is developed using function theory and the theory of linear operators on Hilbert spaces which lends itself to better understanding the spectral properties of the attenuated Radon transform. The continuous attenuated Radon transform reduces to a matrix operator for discrete angular and lateral sampling, and the reconstruction problem reduces to a system of linear equations. For the situation of variable attenuation coefficient frequently found in nuclear medicine applications of imaging the heart and chest, the procedure developed in this thesis involves iterative techniques of performing the generalized inverse. For constant attenuation coefficient less than 0.15 cm^{-1}, convolution methods can reliably reconstruct a 30 cm object with 0.5 cm resolution. However, for high attenuation coefficients or for the situation where there is variable attenuation such as reconstruction of distribution of isotopes in the heart, iterative techniques developed in this thesis give the best results. (ERB)

53715 (PB—290434) **Intravenous elimination and percutaneous absorption of topically applied thioguanine-14c (nsc-752) in yorkshire white pigs. Final report, 22 June-14 October 1977.** Skierkowski, P.; Murphy, J.C.; Watson, E.S.; Folk, R.M.; Pavkov, K.L. (Battelle Columbus Toxicology Program Office, McLean, VA (USA); Mississippi Univ., University (USA). Research Inst. of Pharmaceutical Sciences). 15 Mar 1978. Contract N01-CM-4-3746. 36p. Y A03/MF A01.

The distribution and elimination of intravenously administered Thioguanine-14C (NSC-752) was studied in female, weanling, Yorkshire, white pigs. Approximately one-half the radioactivity was eliminated in the urine in the first six hours, and the majority was eliminated by the end of the 24 hours after intravenous administration. After 96 hours (4 days) an average of 84% was eliminated via the urine. This elimination percentage was then utilized to determine the amount of Thioguanine-14C absorbed after topical application. Among the whole organs sampled, kidney, liver and spleen had the highest specific activities of radioactivity. Intestine and bone marrow samples had the highest specific activity levels of the random tissues sampled. The absorption of the Thioguanine-14C after topical application was minimal with approximately 0.77% of the administered dose being absorbed at the end of 192 hours (8 days). Significant levels of radioactivity were also detected in skin surrounding the site of application.

EXTERNAL RADIATION IN DIAGNOSTICS

REFER ALSO TO CITATION(S) 53721, 53723

MICROBIOLOGY

REFER ALSO TO CITATION(S) 53658

PATHOLOGY

REFER ALSO TO CITATION(S) 53722, 53742, 53743

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 53724

PHYSIOLOGICAL SYSTEMS

REFER ALSO TO CITATION(S) 53742, 53743, 53745, 53750

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 53713, 53715, 53724

53716 (LBL—8668) **Hemopoietic cell precursor responses to erythropoietin in plasma clot cultures.** Kennedy, W.L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1979. Contract W-7405-ENG-48. 153p. P 08/MF A01.

Thesis.

The time dependence of the response of mouse bone marrow cells to erythropoietin (Ep) in vitro was studied. Experiments include studies on the Ep response of marrow cells from normal, plethoric, or bled mice. Results with normal marrow reveal: (1) Not all erythroid precursors (CFU-E) are alike in their response to Ep. A significant number of the precursors develop to a mature erythroid colony after very short Ep exposures, but they account for only ~ 13% of the total colonies generated when Ep is active for 48 hrs. If Ep is active more than 6 hrs, a second population of erythroid colonies emerges at a nearly constant rate until the end of the culture. Full erythroid colony production requires prolonged exposure to erythropoietin. (2) The longer erythropoietin is actively present, the larger the number of erythroid colonies that reach 17 cells or more. Two distinct populations of immediate erythroid precursors are also present in marrow from plethoric mice. In these mice, total colony numbers are equal to or below those obtained from normal mice. However, the population of fast-responding CFU-E is consistently decreased to 10 to 20% of that found in normal marrow. The remaining colonies are formed from plethoric marrow at a rate equal to normal marrow. With increasing Ep exposures, the number of large colonies produced increases. From the marrow of bled mice, total erythroid colony production is equal to or above that of normal marrow. Two populations of colony-forming cells are again evident, with the fast-responding CFU-E being below normal levels. The lack of colonies from this group was compensated in bled mice by rapid colony production in the second population. A real increase in numbers of precursors present in this pool increased the rate of colony production in culture to twice that of normal marrow. The number of large colonies obtained from bled mice was again increased as the Ep exposure was lengthened. (ERB)

AGRICULTURE AND FOOD TECHNOLOGY

REFER ALSO TO CITATION(S) 53735, 54009

BIOMEDICAL SCIENCES, APPLIED STUDIES

RADIATION EFFECTS ON BIOCHEMICALS

IN VITRO

53717 (COO—3221-57) **Quatenary structure of methemoglobin II. Pulse radiolysis study of the binding of oxygen to the valence-hybrid. Progress report, December 1, 1978-November 30, 1979.** Chevion, M.; Ilan, Y.A.; Samuni, A.; Navok, T.; Czapski, G. (Hebrew Univ., Jerusalem (Israel)). 1979. Contract EY-76-C-02-3221. 21p. P 02/MF A01.

The pulse-radiolysis of solutions of adult human methemoglobin was used in order to reduce a single heme-iron within the protein tetramers. The valence-hybrids thus formed were reacted with oxygen. Kinetics of the reactions were studied. The effects of pH and inositol-hexaphosphate were examined. The kinetics of the ligation of oxygen to stripped valence-hybrids showed a single-phase behavior at the pH range 6.5 to 9. As the pH was lowered below 6.5 a second, slower phase became apparent. In the presence of IHP, above pH 8, the kinetics of oxygem binding was of a single phase. As the pH was lowered a transition to a second, slower phase was noticed. Below pH 7 the slower phase was the only detectable one. The analysis of the relative contribution of the faster phase to the total reaction as a function of the pH showed a typical transition curve characterized by a pK = 7.5 and a Hill parameter n =2.9. On the basis it is concluded that human adult stripped methemoglobin resides in an R quarternary structure while the presence of IHP stabilizes the T structure at pH below 7.5.

RADIATION EFFECTS ON CELLS

EXTERNAL SOURCE

53718 (LA—7947-MS) **Near-term and late biological effects of acute and low-dose-rate continuous gamma-ray exposure in dogs and monkeys.** Spalding, J.F.; Holland, L.M. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 11p. P 02/MF A01.

Monkeys (Macaca mulatta) and dogs (beagle) were given thirteen 100-rad gamma-ray doses at 28-day intervals. The comparative response (inury and recovery) of the hematopoietic system of the two species was observed at 7-day intervals during the exposure regime. At 84 days after the thirteenth gamma-ray dose, the 1300-rad conditioned and control dogs and monkeys were challenged continuously with gamma rays at 35 r/day until death to determine the amount of radiation-induced injry remaining in conditioned animals as a reduction in mean survival time. Dogs (50%) and monkeys (8%) died from injury incurred during conditioning exposures. Thus, the comparative response (in terms of lethality) of dogs and monkeys to dose protraction by acute dose fractionation was similar to what we would expect from a single acute dose. The mean survival times for nonconditioned dogs and monkeys during continuous exposure at 35 R/day were the same (~ 1400 h). Thus, the hematopoietic response of the two species by this method of dose protraction was not significantly different. Mean survival times of conditioned dogs and monkeys during the continuous 35-R/day gamma-ray challenge exposure were greater (significant in dogs but not in monkeys) than for their control counterparts. Thus, long-term radiation-induced injury was not measurable by this method. Conditioning doses of more than 4 times the acute $LD_{50}{}^{30}$ in dogs and approximately 2 times that in monkeys served only to increase both mean survival time and variance in a gamma-ray stress environment with a dose rate of 35 R@/day.

RADIATION EFFECTS ON MICROORGANISMS

BASIC STUDIES

53719 **Ultraviolet light induced mutagenesis in Saccharomyces cerevisiae.** Lawrence, C.; Christensen, R.B. (Univ. of Rochester, NY). pp 437-440 of DNA repair mechanisms. Hanawalt, P.C.; Friedberg, E.C.; Fox, C.F. (eds.). New York, NY; Academic Press, Inc. (1978).

UV-induced mutations in Saccharomyces appear to arise from the action of a multi-step, branching process, different branches giving rise to mutations of different kinds or at different genetic sites. Mutations may occur at some distance from the causal photoproduct, and almost always involve single base pair changes. These observations are difficult to explain according to a single-step unitary model of the kind proposed by Radman and may indicate that prokaryotes and eukaryotes differ in this respect.

RADIATION EFFECTS ON ANIMALS

MAN

REFER ALSO TO CITATION(S) 53534, 53723, 53725

53720 (ORNL/TM—6756) **Neutron personnel dosimetry considerations for fusion reactors.** Barton, T.P.; Easterly, C.E. (Oak Ridge National Lab., TN (USA)). Jul 1979. Contract W-7405-ENG-26. 63p. P 04/MF A01.

Thesis. Submitted by T.P. Barton to Purdue Univ., Lafayette, IN.

The increasing development of fusion reactor technology warrants an evaluation of personnel neutron dosimetry systems to aid in the concurrent development of a radiation protection program. For this reason, current state of knowledge neutron dosimeters have been reviewed with emphasis placed on practical utilization and the problems inherent in each type of dosimetry system. Evaluations of salient parameters such as energy response, latent image instability, and minimum detectable dose equivalent are presented for nuclear emulsion films, track etch techniques, albedo and other thermoluminescent dosimetry techniques, electrical conductivity damage effects, lyoluminescence, thermocurrent, and thermally stimulated exoelectron emission. Brief summaries of dosimetry regulatory requirements and intercomparison study results help to establish compliance and recent trends, respectively. Spectrum modeling data generated by the Neutron Physics Division of Oak Ridge National Laboratory for the Princeton Tokamak Fusion Test Reactor (TFTR) Facility have been analyzed by both International Commission on Radiological Protection fluence to dose conversion factors and an adjoint technique of radiation dosimetry, in an attempt to determine the applicability of current neutron dosimetry systems to deuterium and tritium fusion reactor leakage spectra. Based on the modeling data, a wide range of neutron energies will probably be present in the leakage spectra of the TFTR facility, and no appreciable risk of somatic injury to occupationally exposed workers is expected. The relative dose contributions due to high energy and thermal neutrons indicate that neutron dosimetry will probably not be a serious limitation in the development of fusion power.

53721 (PB—291222) **Mammography: increased false positive rates as a result of examining low risk populations.** de la Puente, J.; Smith, A. (National Center for Health Services Research, Hyattsville, MD (USA)). Nov 1977. 15p. Y A02/MF A01.

The authors are familiar with the controversy regarding the relative risk of late detection of breast cancer versus the risk resulting from X-ray exposure, but do not feel qualified to take a position on the matter. Thus, this paper should not be interpreted as a position in favor or against screening indicated populations for breast cancer through the use of mammography. Dedicated diagnostic radiologists, trained in mammography, are often aware of the sensitivity and specificity being delivered by their program, as well as the false positive rates stemming from indicated biopsies. It is hoped that this paper can provide a tool for the continued assessment of these variables at most facilities where mammography is being provided. Sensitivity, specificity, risk, and false positive rates are intimately related.

53722 (RERF-TR—1-77) **Mortality experience of atomic bomb survivors, 1950—1974. Life span study report 8.** Beebe, G.W.; Kato, H.; Land, C.E. (Radiation Effects Research Foundation, Hiroshima (Japan); Radiation Effects Research Foundation, Nagasaki (Japan). Nagasaki Branch). 1977. Contract EX-76-C-28-3161. 443p. (In Japanese and English). P 19/MF A01.

The entire 1950—1974 mortality experience has been reanalyzed with particular attention to these questions: (1) is radiation carcinogenesis the only important late effect from the standpoint of mortality; (2) is the carcinogenic effect a general one, affecting all tissues and histologic types; (3) are there reliable city differences from which relative biological effectiveness (RBE) estimates could be made; (4) are Nagasaki data numerous enough to permit any close examination of the functional form of the gamma dose-response curve for specific cancers; and (5) can further insight be gained into the role of age in 1945 at the time of the bomb (ATB) upon the carcinogenic effect of ionizing radiation. Mortality from diseases other than cancer is thus far unrelated to ionizing radiation. Carcinogenic effects generally are not proportional to spontaneous incidence. Evidence of radiation carcinogenesis is much stronger in Hiroshima than in Nagasaki. Absolute risks per rad are higher in Hiroshima where neutrons contribute substantially to the total dose. The leukemogenic effect seems still to be present, especially in those aged 20 to 34 ATB. Age ATB plays an important role in the carcinogenic effect. In general the absolute risk, averaged over the entire period, increases with age ATB. For none of the specific types of cancer except leukemia in Hiroshima are the data numerous enough to permit confident statements to be made about the shape of the dose-response curve in the low-dose region. The leukemogenic effect that dominated any consideration of late mortality effects until recently has now been exceeded by the effect of radiation on forms of cancer other than leukemia. At the end of 1974 excess deaths numbered about 85 for leukemia and 100 for other forms of cancer among the 82,000 A-bomb survivors under study. (ERB)

VERTEBRATES

53723 (COO—3017-39) **Radiation carcinogenesis. Progress report VI, 16 May 1978—15 May 1979.** Warren, S.; Gates, O. (New England Deaconess Hospital, Boston, MA (USA). Cancer Research Inst.). 1979. Contract EY-76-S-02-3017. 30p. P 03/MF A01.

Asbestos fibers, Canadian and Rhodesian chrysotile, have induced mesotheliomas and pleural plaques in mice and rats. The pathogenesis of the lesions is being studied. Proliferation of the adrenal cortical A cells is accelerated in time and enhanced in extent by ionizing radiation in female RAP mice. The development of cortical tumors was significantly correlated with extensive A cell proliferation. Whole-body protracted doses, above 500 rads, were followed by a 9% tumor incidence. Endocrine neoplasia in mice appears related to functional ties between several endocrines particularly adrenal, ovary, and pituitary. A study of the spontaneous benign and malignant tumors ocurring in control NEDH rats has provided background for the tumorigenic effects of radiation and also of altered hormonal internal milieu. Begin tumors have been produced by radiation in a wide variety of tissues for the first time, providing data as to the relative responsiveness in benign tumor production of various tissues to a dose of 1000 rads. The hormonal changes secondary to parabiosis and hemi-irradiation of the pair are important. A radiation-induced functioning pheochromocytoma causing hypertension and death has been found widely useful by investigators. A radiation-induced malignant insulinoma has also been widely used, and insulin-producing DNA from it has served in the hands of others through genetic engineering to provide an insulin-producing strain of the bacillus E. coli.

53724 (UR—3490-1674) **Influence of x irradiation and diet on pituitary/thyroid function in the rat.** Qassar, I.G. (Rochester Univ., NY (USA). Dept. of Radiation Biology and Biophysics). 1979. Contract EY-76-C-02-3490. 59p. P 04/MF A01.

Thesis.

Rats were maintained on low iodine diet or treated with T_4. A significant increase in thyroid weight was observed in rats on low iodine diet whereas among rats on normal diet with thyroxine injections, the thyroid was lower in weight than thyroids of control animals. Pituitary weight increased significantly in rats on low iodine diet or T_4 treatment. Labelling index was significantly higher in the group on low iodine diet. A significantly lower labelling index was observed after thyroxine treatment. Where PTU was administered to rats pretreated with either normal diet, normal diet plus T_4, or maintained on low iodine diet and then exposed to radiation (100 to 400R) to the neck, it was not possible to distinguish the effect of such local radiation on body growth. The pre-radiation treatment did not have any effect on thyroid weight during two weeks post-radiation, suggesting that a four week post-radiation period is essential to elicit radiation effects on the thyroid. Contrary to low iodine treatment, administration of PTU did not result in any increase in pituitary weight in rats maintained on normal diet prior to radiation or in rats maintained on low iodine diet prior to radiation. There was, however, a significant increase in pituitary weight in rats injected with thyroxine prior to radiation (250R or 400R). A significant increase in serum TSH was observed two weeks after radiation and PTU treatment. A lower TSH level was observed, however, in the 250R sub-group (normal diet or T_4 injection) and in the 400R sub-group (low iodine diet). There was a significant difference among sham-irradiated and the three x-irradiated sub-groups maintained on low iodine diet. The results of these studies indicate that local x irradiation with 100 to 400R to the neck may influence thyroid/pituitary function in the rat. (ERB)

MAN

REFER ALSO TO CITATION(S) 53725

NUCLIDE KINETICS AND TOXICOLOGY

MAN

REFER ALSO TO CITATION(S) 53650, 53651, 53652, 53714

53725 (CONF-790594—1) **CONDOS methodology for evaluation of radiation exposure from consumer products.** O'Donnell, F.K. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 14p. P 02/MF A01.

From 11. national conference on radiation control; Oklahoma City, OK, USA (6 May 1979).

The CONDOS methodology is a tool for estimating radiation doses to man from exposures to radionuclides incorporated in consumer products. It consists of two parts: (1) an outline, checklist, and selected data for modeling the life span of a product or the material from which it is made; and (2) a computer code that uses the life-span model to calculate radiation doses to exposed individuals and population groups. (ERB)

PLANTS

REFER ALSO TO CITATION(S) 53650

MICROORGANISMS

REFER ALSO TO CITATION(S) 53700

THERMAL EFFECTS

REFER ALSO TO CITATION(S) 53691

CHEMICALS METABOLISM AND TOXICITY

REFER ALSO TO CITATION(S) 52433

CELLS

REFER ALSO TO CITATION(S) 53744

53726 (CONF-771114—, pp 204-218) **Cytotoxicity of untreated coal-conversion gasifier condensate.** Schultz, T.W. (Univ. of Tennessee, Knoxville); Dumont, J.N.; Kyte, L.M. Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

The possible environmental effects of an untreated gasifier condensate (filtered product water from the Synthane gasification process) are examined. Populations of the ciliate, Tetrahymena pyriformis, were exposed to varying concentrations of condensate; and their behavior, respiration, cytology, and growth rates were investigated. Concentrations of 1% and less cause little if any behavioral (shape and motility) changes, but concentrations of 2% and greater decrease motility and increase cell lysis. The condensate causes a nonlinear, dose-dependent reduction in oxygen consumption. At concentrations of less than 2%, no alteration in respiration is noted over a 300-min exposure. At all concentrations tested, the most striking cytological alterations are in the mitochondrial matrixes, which become more electron dense. Cell membranes are also disrupted, and mucocysts are discharged. Population growth is reduced by concentrations of product water as low as 0.2% and is completely inhibited by concentrations of product water as low as 0.2% and is completely inhibited by 1% concentration. The density of test populations plateaus at values inversely related to concentration. Pure phenolic compounds elicit similar responses.

53727 **Temporal acquisition of enhanced fibrinolytic activity by Syrian hamster embryo cells following treatment with benzo(a)pyrene.** Barrett, J.C. (Johns Hopkins Univ., Baltimore, MD); Crawford, B.D.; Grady, D.L.; Hester, L.D.; Jones, P.A.; Benedict, W.F.; Ts'o, P.O.P. *Cancer Res.;* **37**: 3815-3823(Oct 1977).

Following treatment of Syrian hamster embryo cells with benzo(a)pyrene, the time required for the expression of enhanced fibrinolytic activity was examined. For this study, the fibrin-agarose overlay method was developed to distinguish the activity of normal and transformed colonies of hamster cells. Colonies possessing enhanced fibrinolytic activity were not observed 8 days after treatment, but they were observed following one passage (2 weeks after treatment). Morphologically transformed colonies, which exhibited no enhanced fibrinolytic activity, were observed 8 days following treatment. In contrast to these two early changes, cells capable of growth in soft agar were observed much later (6 to 8 weeks after treatment). Untreated Syrian hamster embryo cells generally senesced and did not exhibit enhanced fibrinolytic activity. Approximately 1 of 10 untreated cultures escaped senescence and evolved as a continuous cell line; such cultures frequently exhibited enhanced fibrinolytic activity. These results suggest that the acquisition of enhanced fibrinolytic activity, while perhaps not a cause of neoplastic transformation, may reflect a loss of control of the normal function of the cellular genetic apparatus during the process of transformation.

MICROORGANISMS

REFER ALSO TO CITATION(S) 53597, 53734, 53738, 53744

53728 (BNL—51002, pp 79-95) **Toxicology and carcinogenicity of oil shale products.** Barkley, W.; Warshawsky, D.; Radike, M. (Univ. of Cincinnati Medical Center, OH). Mar 1979.

From Symposium on assessing the industrial hygiene monitoring needs for the coal conversion and oil shale industries; Upton, NY, USA (5 Nov 1978).

Animal studies using shale oil and shale oil products have shown that they are relatively low in acute toxicity. However, there is great concern about the long term effects of these products. One such concern is the carcinogenic properties of shale oil. Studies indicated that raw shale oils, produced by a number of retort methods, are carcinogenic for the mouse's skin. The content of benzo(a)pyrene in these oils was quite low and could not account for the carcinogenic activity. It is likely that other carcinogens and perhaps cocarcinogens are involved.

53729 (BNL—51002, pp 273-287) **Screening techniques for biological activity.** Daisey, J.M.; Mukai, F. (New York Univ. Medical Center, NY). Mar 1979.

From Symposium on assessing the industrial hygiene monitoring needs for the coal conversion and oil shale industries; Upton, NY, USA (5 Nov 1978).

Some of the in vitro bioassays which are presently available for monitoring industrial environments are discussed, and their applicability to the evaluation of occupational exposures in the coal conversion and shale oil industries are considered. As no direct assessment of the degree of human hazard can be made from the results of such tests, the choice of appropriate standards for comparison are discussed. The advantages and limitations of such systems are considered, and research needs for the application of industrial monitoring are suggested.

53730 (CONF-771114—, pp 290-300) **Impact of arsenicals on nitrification in aqueous systems.** Holm, H.W.; Cox, M.F. (Environmental Protection Agency, Athens, GA). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

The impact of both arsenate and cacodylic acid (at arsenic concentrations of 0, 0.1, 1, 10, 100, and 1000 mg/l) on mixed populations of nitrifiers in model aqueous systems containing ammonia was determined by measuring levels of ammonia and nitrite over a 24-day incubation period. Arsenate decreased the rate of oxidation of ammonia by Nitrosomonas only at high concentrations (100 and 1000 mg/l) of arsenic; low levels of arsenate (0.1, 1, and 10 mg As/l) had no effect on the oxidation rate, in comparison with arsenic-free controls. The oxidation of nitrite to nitrate by Nitrobacter was affected by all concentrations of arsenic added as arsenate; low concentrations (0.1, 1, and 10 mg/l) delayed the oxidation of nitrite and high concentrations (100 and 1000 mg/l) inhibited the process. The only impact of cacodylic acid on nitrification occurred at 1000 mg As/l. The oxidation of ammonia by Nitrosomonas was delayed by the arsenical, but the Nitrobacter population was not affected. Although cacodylic acid is not toxic to the nitrification process, its degradation product, arsenate, can inhibit nitrification if it is in an available form. This inhibition of the Nitrobacter population may promote the accumulation of nitrite in the environment.

53731 (LBL—9037, pp 169-176) **Chemical and biological aspects of organic particulates in real and simulated atmospheres.** Pitts, J.N. Jr.; Van Cauwenberghe, K.A.; Grosjean, D.; Schmid, J.P.; Fitz, D.R.; Belser, W.L. Jr.; Knudson, G.B.; Hynds, P.M. (Univ. of California, Riverside). Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

The discovery of direct mutagenic activity, as determined by the Ames Salmonella typhimurium reversion assay, in the organic fractions of ambient aerosols collected throughout Southern California, led to an investigation of the reactions of benzo(a)pyrene (BaP) deposited on glass fiber filters with ambient photochemical smog, as well as with O_3, NO_2, and peroxyacetyl nitrate (PAN) in simulated atmospheres. A variety of products are readily formed, including phenols, diphenols, dihydrodiols, quinones, etc. Directly mutagenic nitroderivatives are formed upon exposure of BaP (a carcinogen) and of perylene (a non-carcinogen) to 1 ppM of NO_2 in air containing traces of nitric acid ($\sim$ 10 ppB). If such reactions occur in urban atmospheres they may account in part for the excess carcinogenicity (over BaP and certain other polycyclics) observed in organic particulates collected from smog and exhausts of gasoline and diesel engines. However, historically, such gas—solid interface processes may also have occurred on the filters used in particulate sampling. Thus the possibility of filter artifacts must be recognized.

53732 (LBL—9037, pp 187-192) **Mutagenic activity in organic fractions of airborne particulate matter.** Daisey, J.M.; Hawryluk, I.; Kneip, T.J.; Mukai, F. (New York Univ., NY). Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

Airborne particulate matter collected recently in New York City was sequentially extracted with cyclohexane, dichloromethane, and acetone respectively, to extract nonpolar and polar organic compound fractions. The fractions were assayed for mutagenic activity with the Ames Salmonella typhimurium test system. Direct-acting mutagens (no microsomal activation) of a wide range of polarity have been found in both the winter and summer aerosol samples. The moderately polar, dichloromethane extractable compounds exhibited the greatest activity. These results indicate the presence of biologically active compounds other than polycyclic aromatic hydrocarbons. Ongoing separation work indicates the presence of more than one compound or class of compounds although structures have yet to be determined.

53733 (LBL—9037, pp 193-198) **Mutagenic activity of fossil fuel combustion products.** Kaden, D.A.; Thilly, W.G. (Massachusetts Inst. of Tech., Cambridge). Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

The methylene chloride extracts of several soots, containing the polycyclic aromatic hydrocarbon fraction, were examined for their mutagenic activity in Salmonella typhimurium. Resistance to the purine analog 8-azaguanine was used as a genetic marker. To allow metabolism of pro-mutagens to their biologically active forms, a postmitochondrial supernatant drug-metabolizing system derived from livers of phenobarbitol and/or aroclor pretreated rats was incorporated into all assays. The observed mutagenicity of the soot extracts was ten to twenty times higher than could be accounted for by the amount of benzo(a)pyrene present. Synergistic activity between benzo(a)pyrene and other components of the soot extracts was discounted by the simple additive mutagenicity of soot extract and added benzo(a)pyrene. The predominant polycyclic aromatic hydrocarbon components of a representative soot extract were quantitatively assayed for their mutagenic potential. Nine of these components were found to be mutagenic to S. typhimurium. Two components, perylene and acepyrylene, exhibit more mutagenic activity than benzo(a)pyrene on a equimolar level. Utilizing the measured mutagenic activities of the polycyclic aromatic hydrocarbon components of a fresh kerosene soot sample, the mutagenicity of the methylene chloride extract was attributed to an additive contribution of its various components.

PLANTS

53734 (CONF-771114—, pp 241-272) **Mercury contamination standards for marine environments.** Eisler, R. (Environmental Protection Agency, Narragansett, RI). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

Selected technical literature on biological and ecological effects of mercury compounds on marine and estuarine biota is reviewed. Potential and actual hazards to public health through marine vectors are considered. Within this framework, approaches for establishing mercury contamination standards in saline environments are presented.

53735 (LETC/RI—79/4) **Plant responses to aqueous effluents derived from in situ fossil fuel processing. I. Development of screening methods.** Skinner, Q.D.; Moore, T.S.; Asplund, R.O.; Sexton, T.C.; Farrier, D.S. (Department of Energy, Laramie, WY (USA). Laramie Energy Technology Center). Jul 1979. 29p. P 03/MF A01.

Possible mechanisms for bioenvironmental contact of aqueous effluents derived from in situ oil shale processing include accidental, episodic exposure resulting from failure of a containment, leakage during transfer or treatment processes, or contamination and subsurface migration of ground waters to a surface outlet. The magnitude of plant responses and phytotoxic effects resulting from such exposure has not been but needs to be quantified for purposes of risk assessment. The development of control technologies for aqueous effluents looks forward to the potential of using suitably treated process waters for land reclamation purposes. A research project to address plant and process water relationships has been developed. The initial objectives of the project are to: (1) develop quantitative, short-term, cost-effective, diagnostic screening procedures for vegetation; (2) using such procedures, to quantitate the response of selected plants to process waters derived from in situ oil shale processing; (3) provide information for developing control technology. Results meeting the first-stated objective are presented. Two screening procedures, a seed germination assay and growth and development response assays, have been developed using an in situ oil shale process water. (ERB)

INVERTEBRATES

REFER ALSO TO CITATION(S) 53726, 53734

53736 (CONF-771114—, pp 273-289) **Radioisotopic study of mercury uptake by Hudson River biota.** Zubarik, L.S.; O'Connor, J.M. (New York Univ. Medical Center, Tuxedo). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

Planktonic organisms from the Hudson River were exposed to various forms of mercury (^{203}Hg) to evaluate the role of estuarine forage organisms in the kinetics of toxic metal transport in aquatic systems. Mercury accumulation was expressed as concentration per unit time. Concentration factors ranged from 10^2 to 10^6 times that in the filtered river water. Mercury-203 uptake was greater in microzooplankton and algae than in macrozooplankton and fish larvae. The amphipod Gammarus sp. was tested to determine if differences in mercury uptake could be related to the form of mercury or to changes in environmental conditions. Exposure to two inorganic forms of mercury (mercuric nitrate and mercuric chloride) and two organic forms of mercury (methyl mercury chloride and phenyl mercuric acetate) showed no differences in concentrations of the four forms of mercury after a 1-day exposure. Concentration of the organic forms by Gammarus sp. was three times greater than that of inorganic mercury compounds after exposure for 1 week. Studies of mercury uptake throughout the year showed that uptake of all the mercury compounds tested increased during the summer months, but uptake of organic compounds increased to a greater extent than that of inorganic compounds. Temperature change was shown to be an important variable for determining the degree of uptake; however, no single environmental parameter adequately explained the seasonal fluctuations in mercury uptake.

53737 (CONF-771114—, pp 301-315) **Copper sensitivity of adult Pacific oysters.** Harrison, F.L.; Rice, D.W. Jr. (Lawrence Livermore Lab., CA). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

Sensitivity of the Pacific oyster, Crassostrea gigas, to copper was evaluated in experiments of about 2-weeks duration. Groups of 8 to 10 animals were exposed to copper concentrations ranging from 100 to 1300 μg/liter in a high-volume flow-through bioassay system. Copper concentrations in the oysters and the major chemical form of copper in the water were determined. In addition, experiments were performed with ^{64}Cu to determine accumulation rates and distribution. The family of mortality curves of time vs. concentration for oysters was unlike that for other organisms in that the greatest mortality at 96 hr occurred in animals at intermediate rather than high copper concentrations. However, typical mortality curves were obtained by correcting the duration of copper exposure of each oyster by a factor related to the amount of time the shells were open. Significant mortalities occurred at copper concentrations of 200 μg/liter, and higher. Analysis of the data yields an LC_{50} at 48 hr of 650 μg/liter, an LC_{50} at 96 hr of 430 μg/liter, and an incipient LC_{50} of 230 μg/liter. Distributions of ^{64}Cu in oysters after a 24-hr exposure differed in animals maintained in water containing high and low concentrations of copper. The flux of copper into tissues was related to copper concentrations in the water; this indicated that there was little metabolic regulation.

53738 (CONF-771114—, pp 316-330) **In situ study of cadmium stress in a natural zooplankton community.** Marshall, J.S.; Mellinger, D.L. (Argonne National Lab., IL). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

The effects of elevated cadmium concentrations on a natural zooplankton community were studied in situ in Green Bay, Lake Michigan, during the summer of 1976, with polyethylene carboys as enclosures. The results of five experiments showed that cadmium concentrations as low as 5 μg/l, the lowest concentration tested, caused large and highly significant effects ($P < 0.001$) on both functional and structural attributes of the zooplankton community within 9 days. The effects of enclosure up to 15 days were mostly insignificant. Functional responses, as indicated by changes in the different species' rates of increase, showed highly significant differences ($P < 0.001$) among total Cladocera, Calanoida, and Cyclopoida, but no differences among species in each of these major groups. Structural responses included reduced total abundance, species diversity (3 indexes), and community similarity (2 indexes). The results indicate that added cadmium concentrations much lower than 5 μg/l probably would cause detectable effects within 9 days and that incubations up to 15 days are feasible.

53739 (PB—289883) **Environmental effects of western coal surface mining. Part II: the aquatic macroinvertebrates of Trout Creek, Colorado. Final report.** Canton, S.P.; Ward, J.V. (Colorado State Univ., Fort Collins (USA). Natural Resources Ecology Lab.; Montana State Univ., Bozeman (USA). Fisheries Bioassay Lab.). Oct 1978. 73p. Y A04/MF A01.

A study was conducted on Trout Creek in northwestern Colorado to assess effects of coal mine drainage on stream macroinvertebrates. Density and biomass exhibited a general increase in the downstream direction throughout the study area and showed marked seasonal variation. Aquatic insects comprised over 90% of the fauna with caddisflies (Trichoptera) predominating. Diversity did not vary significantly throughout the study area. None of the parameters measured showed any definite indication of stressed conditions in the macroinvertebrate community during the study period. Water quality was diminished primarily during spring runoff and the invertebrates seemed able to withstand this short period of water quality degradation.

VERTEBRATES

REFER ALSO TO CITATION(S) 53728, 53734, 53736

53740 (AD-A—062138) **Toxic hazards research unit, annual technical report. 1978. Report, for June 1977-May 1978.** MacEwen,

J.D.; Vernot, E.H. (California Univ., Dayton, OH (USA)). Aug 1978. Contract F33615-76-C-5005. 129p. Y A07/MF A01.

The research programs of the Toxic Hazards Research Unit (THRU) for the period of June 1977 through May 1978 are reviewed in this report. Subchronic inhalation toxicity studies were conducted on decalin, JP-5 and DFM. Studies were carried out on the oncogenicity of inhaled hydrazine, 1,1-dimethylhydrazine and monomethylhydrazine. Acute oral, dermal and inhalation toxicity studies were conducted on a large variety of chemical agents used by the Air Force and Navy or transported in interstate commerce. Sensitization, eye and skin irritation studies were also made on these chemicals. (Author)

53741 (CONF-771114—, pp 219-240) **Aquatic toxicology of trace elements of coal and fly ash.** Birge, W.J. (Univ. of Kentucky, Lexington). Dec 1978.

From 5. ecological symposia on energy and environmental stress in aquatic systems; Augusta, GA, USA (2 Nov 1977).

Aquatic bioassays were performed on 22 coal elements, with developmental and juvenile stages of fish and amphibians used as test organisms. For more sensitive test species, LC_{50} values of 0.1 ppM or less were observed for 15 trace elements; and LC_1 values ranged down to 0.1 to 0.2 ppB for mercury and silver. Studies also were performed on the aqueous leaching characteristics and toxicological properties of coal-produced fly ash. Chemical characteristics of the simulated effluent compared closely with those recorded for actual ash-settling ponds. During the first 500 hr of operation, conductivity averaged 690 μmhos/cm; and a mean of 0.56 g/liter was observed for total dissolved solids. Gradual decreases were observed thereafter. Effluent pH averaged 4.3 during the first 500 hr but approached the level of influent water (7.1 to 7.9) by 2000 hr. Maximum effluent concentrations detected for seven selected metals were 126 ppM Al, 766 ppB Zn, 518 ppB Cu, 500 ppB Cd, 370 ppB Ni, 87 ppB Hg, and 8 ppB Ag. Mean concentrations for the first 500 hr of elution were 32.6 ppM Al, 350 ppB Zn, 156 ppB Cd, 155 ppB Ni, 110 ppB Cu, 2.1 ppB Ag, and 1.8 ppB Hg. All metals except mercury reached maximum levels within 500 hr, and concentrations declined thereafter. Mean mercury levels increased to 27 to 15 ppB for second and third 500-hr elution intervals. After 522 and 1033 hr of elution time, continuous-flow treatment with undiluted ash effluent produced 100% mortality of frog and sunfish eggs. A 0.1 dilution at 1033 hr resulted in 42% hatchability of sunfish eggs. After 1775 hr of continuous leaching, undiluted ash effluent and 0.1 and 0.01 dilutions gave survival frequencies of 57, 76, and 88% for goldfish eggs, compared with 92% for controls. Metals analyzed for undiluted effluent administered to goldfish were well below LC_1 determinations, except aluminum, which was present at the LC_{50} level.

53742 (COO—4800-5) **Effect of chemical carcinogens on hematopoietic stem cells: temporal correlation between methyl methane sulfonate induced depression of CFU-S and potentiation of Friend viral leukemogenesis in vivo.** Raikow, R.B.; OKunewick, J.P.; Meredith, R.F.; Brozovich, B.J.; Seeman, P.R. (Allegheny-Singer Research Corp., Pittsburgh, PA (USA). Div. of Radiation Oncology). May 1979. Contract EP-78-S-02-4800. 15p. P 02/MF A01.

Methyl methane sulfonate (MMS) was shown to reduce the number of transplantable pluripotent hematopoietic stem cells (CFU-S) in the mouse spleen. A mild depression in CFU-S numbers was seen as early as 1 hr after injection of the chemical carcinogen. Maximal depression was found to be at 5 hrs, followed by a recovery of up to 75% of normal levels by 24 hrs. Comparison of the data with earlier reslts which demonstrated a potentiating effect of MMS on viral leukemogenesis in vivo revealed a good temporal correlation, suggesting a possible relationship between the two effects.

53743 (LETC/RI—79/3T) **Animal toxicity evaluation of an in situ oil shale retort water.** Hepler, D.I.; Schafer, A.S.; Larson, K.A.; Farrier, D.S. (Department of Energy, Laramie, WY (USA). Laramie Energy Technology Center). Jul 1979. 39p. P 03/MF A01.

The results of exposure studies, acute toxicity studies, and reproduction-developmental studies undertaken to define health risks associated with occupational exposure to a retort water sample are discussed. This investigation represents the first animal toxicity evaluation of a retort water and therefor incorporated a broad base of various tests selected to determine toxicity as a function of exposure route and species exposed. Results are interpreted as to their occupational health significance. On the basis of this study a limited number of specific tests have been selected for use in cost-effective, comparative screening of additional retort waters and waters significant to oil shale processing, in general (ERB)

53744 (ORNL—5576) **Toxicity and mutagenic evaluation: tetramethylammonium borohydride.** Holland, J.M.; Epler, J.L. (Oak Ridge National Lab., TN (USA)). Aug 1979. Contract W-7405-ENG-26. 16p. P 02/MF A01.

The toxicity and mutagenicity of tetramethylammonium borohydride were determined in mammals and microorganisms, respectively. The acute oral LD_{50} was determined in mice and rats, skin irritation and sensitization in guinea pigs, percutaneous toxicity in rabbits, eye irritation in rabbits, pulmonary toxicity in rats, and mutagenicity in Salmonella (Ames test) and cultured human leukocytes. (ERB)

53745 (UR—3490-1533) **Operant behavior of rats exposed before or after weaning to low levels of lead.** Angell, N.F. (Rochester Univ., NY (USA). Dept. of Radiation Biology and Biophysics). 1978. Contract EY-76-C-02-3490. 130p. P 07/MF A01.

Thesis.

Rats were exposed to lead under one of three conditions. One group received lead by suckling dams who had their drinking water replaced with a solution of 0.2% lead acetate. A second group was placed on the same concentration of lead-treated drinking water at weaning. A third group received both preweaning and postweaning treatments. Behavioral testing was begun of day 58. The median blood lead concentration at weaning was 100 μg percent. On day 133, the blood lead concentrations of the two groups exposed postweaning were 65 μg percent while the preweaning group had dropped to 9 μg percent. The only overt signs of lead exposure occurred in the group exposed both preweaning and postweaning. This group showed a slight retardation of growth between weaning and day 54 of life. These low levels of lead exposure produced subtle alterations in behavior. The two groups exposed postweaning showed a statistically significant lengthening of the median interresponse time. In the ratio size manipulation, the control group showed an approximately linear trend when ratio size was plotted against time to the first response in the ratio. No such trend was evident in the lead exposed groups. The results of this study lead to the speculation that low blood lead concentrations produce increases in response rate, while higher blood lead concentrations result in lowered response rates. Behavioral, neuropathological, and neurochemical evidence is consistent with the hypothesis that lead produces behavioral effects by interfering with dopaminergic neurotransmission. The results indicate that current standards of 40 μg percent for children may be too high. Such lead concentrations could produce behavioral damage with serious, long-term consequences. (ERB)

53746 (UR—3490-1658) **Absorption, distribution and excretion of inhaled hydrogen fluoride in the rat.** Morris, J.B. (Rochester Univ., NY (USA). Dept. of Radiation Biology and Biophysics). 1979. Contract EY-76-C-02-3490. 308p. P 14/MF A01.

Thesis.

Rats were subjected to whole body HF exposure for 6 hrs or to nose-only HF exposure for 1 hr. Total and/or ionic fluoride concentrations in selected tissues were determined at various times following exposure. In rats sacrificed 6 hrs after whole body exposure, dose-dependent increases in lung, plasma, and kidney total and ionic fluoride concentration occurred. Rats excreted more fluoride in the urine after whole body exposure than could be explained by the amount of HF inhaled. Considerable evidence suggests that airborne HF deposits on fur and is then ingested due to preening activity. Urinary fluoride excretion was increased by nose-only exposure. The urinary fluoride excretion accounted for approximately twice the fluoride estimated to be inhaled during exposure. Tissue fluoride concentrations were elevated immediately after nose-only exposure. Fluoride concentrations in lung and kidney returned to control levels within 12 hrs. Plasma fluoride concentration was slightly elevated 24 hrs after the start of the 1 hr exposure but was at control levels at 96 hrs. Immediately following nose-only exposure, lung ionic fluoride concentrations were less than plasma ionic fluoride concentrations suggesting that the fluoride in the lung had reached that site via plasma transport rather than by inhalation. A dose-dependent increase in plasma ionic fluoride concentration occurred after upper respiratory tract HF exposure providing strong evidence that fluoride is absorbed systemically from that site. The plasma ionic fluoride concentration after upper respiratory tract exposure was of sufficient magnitude to account for the plasma fluoride concentrations observed in intact nose-only exposed rats. (ERB)

53747 **Environmental health criteria 4: oxides of nitrogen.** Geneva, Switzerland; World Health Organization (1977). vp.

This publication starts with a summary of recommendations for more research. The chemistry sources, environmental levels, and effects of oxides of nitrogen on animals and man are included; and the concluding section is an evaluation of health risks. It mentions that oxides of nitrogen are formed in welding.

MAN

REFER ALSO TO CITATION(S) 53723, 53734, 53747

53748 (BNL—51002, pp 153-171) **Criteria for occupational health monitoring in the fossil fuel conversion industries.** White, O. Jr. Mar 1979.

From Symposium on assessing the industrial hygiene monitoring needs for the coal conversion and oil shale industries; Upton, NY, USA (5 Nov 1978).

The focus of this paper is to provide the occupational health professional with a criteria that will assist in establishing priorities in occupational health monitoring programs for the synthetic fuel industries. Elements which must be considered in establishing monitoring criteria are as follows: identification of hazardous operations and processes; hazard classification of contaminants; identification of workforce members at high risk; total risk assessment involving all occupational safety and health hazards; and monitoring strategy.

53749 Environmental health criteria 3: lead. Geneva, Switzerland; World Health Organization (1977). vp.

This WHO booklet goes very thoroughly into the many facets of the lead problem. The properties of the metal are described and the analytical methods needed to detect and measure it are discussed. The need for standardization of methods is stressed since at present it is almost impossible to compare the results of one laboratory with another on an international scale. Sources, transport and distribution, environmental levels, metabolism and experimental studies are discussed. The publication ends with a description of the effects of lead on man. This is a handy and well produced publication by a group of eminent men.

53750 Clinical chemistry and chemical toxicology of metals. Brown, S.S. Amsterdam, Netherlands; Elsevier/North-Holland Biomedical Press (1977). 410p.

Forty of the 90 papers presented at the symposium were organized by the Commission on Toxicology of the International Union of Pure and Applied Chemistry, Section on Clinical Chemistry, at Monte Carlo, 2-5 Mar 1977. Clinical and epidemiological case histories and cellular and molecular mechanisms of metal toxicity are discussed. Lead, cadmium, aluminum, mercury, zinc, nickel, cobalt, and arsenic are covered under the following main subject headings: essentiality and toxicity of metallic elements; metabolic targets; tissue and cellular toxicology; poisoning with cadmium, lead, nickel, arsenic, and other metals; specimen preparation and analysis; analytical methods; reference technology.

OTHER ENVIRONMENTAL POLLUTANT EFFECTS

REFER ALSO TO CITATION(S) 53641, 53642, 53643

53751 (EPRI-EA—1123(Vol.2)) **Biological effects of high-voltage electric fields: an update. Volume 2. Bibliography. Final report.** (IIT Research Inst., Chicago, IL (USA)). Jul 1979. 269p. P 12/MF A01.

The objective of this project was to collect and review the literature which has become available since mid-1974 on the subject of biological effects of power frequency electric fields. The literature published prior to that date was reviewed as a part of a previous state-of-the-art review and program plan (EPRI RP-381-1). Some 2000 new entries of both publications and research programs in progress have been identified through a computer-aided literature search. Approximately 50 of these entries were selected by the authors of this update for in-depth consideration. This reduction was accomplished by considering only those entries that were deemed to be of direct interest, and by using several comprehensive and detailed reviews to guide the selection process. The general findings of this update confirm the conclusion of the 1975 review that it is highly improbable that electric fields from transmission lines have any significant biological effects on healthy individuals who encounter such fields in a normal way under ordinary conditions. However, further research is still needed in order to understand the nature and extent of any effects that could be harmful.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 53748

53752 (BNL—51002, pp 213-222) **Portable fluorometric monitor to detect PNA contamination of work area surfaces.** Schuresko, D.D.; Jones, G. Jr. (Oak Ridge National Laboratory, TN). Mar 1979.

From Symposium on assessing the industrial hygiene monitoring needs for the coal conversion and oil shale industries; Upton, NY, USA (5 Nov 1978).

Survey monitoring in coal conversion work areas for surface contamination caused by spill, leakage, or contact transfer of material containing carcinogenic polynuclear aromatic hydrocarbon (PNA) compounds or mutagenic acridenes is essential for the health and safety of personnel. A portable direct-reading instrument, similar in function to the familiar radiological survey devices, is required for this type of survey monitoring. The instrument must be capable of functioning during actual plant operation in variable working environments, detecting material spilled on various work surfaces, including machinery, plumbing, construction materials, and on personnel and clothing, and being easily and reliably operated by all plant personnel (laborers, technicians, and staff). The portable fluorescence spotter currently under development has the desired capabilities. This instrument, which in final form will consist of an optical unit that contains fluorescence excitation and detection systems and is connected by an umbilical cable to a battery-powered electronics unit, will enable remote monitoring of work area surfaces at distances of 0 to 2 meters. A schematic diagram of the prototype spotter is included. Sensitivities of the spotter to various coal conversion oils and solvents are tabulated.

53753 (ORNL/TM—6981/V1) **Materials Safety Data Sheets: the basis for control of toxic chemicals.** Ketchen, E.E.; Porter, W.E. (Oak Ridge National Lab., TN (USA)). Sep 1979. Contract W-7405-ENG-26. 496p. P 21/MF A01.

The Material Safety Data Sheets contained in this volume are the basis for the Toxic Chemical Control Program developed by the Industrial Hygiene Department, Health Division, ORNL. The three volumes are the update and expansion of ORNL/TM-5721 and ORNL/TM-5722 Material Safety Data Sheets: The Basis for Control of Toxic Chemicals, Volume I and Volume II. As such, they are a valuable adjunct to the data cards issued with specific chemicals. The chemicals are identified by name, stores catalog number where appropriate, and sequence numbers from the NIOSH Registry of Toxic Effects of Chemical Substances, 1977 Edition, if available. The data sheets were developed and compiled to aid in apprising the employees of hazards peculiar to the handling and/or use of specific toxic chemicals. Space limitation necessitate the use of descriptive medical terms and toxicological abbreviations. A glossary and an abbreviation list were developed to define some of those sometimes unfamiliar terms and abbreviations. The page numbers are keyed to the catalog number in the chemical stores at ORNL.

53754 (ORNL/TM—6981/V2) **Materials Safety Data Sheets: the basis for control of toxic chemicals.** Ketchen, E.E.; Porter, W.E. (Oak Ridge National Lab., TN (USA)). Sep 1979. Contract W-7405-ENG-26. 478p. P 21/MF A01.

The Material Safety Data Sheets contained in this volume are the basis for the Toxic Chemical Control Program developed by the Industrial Hygiene Department, Health Division, ORNL. The three volumes are the update and expansion of ORNL/TM-5721 and ORNL/TM-5722 Material Safety Data Sheets: The Basis for Control of Toxic Chemicals, Volume I and Volume II. As such, they are a valuable adjunct to the data cards issued with specific chemicals. The chemicals are identified by name, stores catalog number where appropriate, and sequence numbers from the NIOSH Registry of Toxic Effects of Chemical Substances, 1977 Edition, if available. The data sheets were developed and compiled to aid in apprising the employees of hazards peculiar to the handling and/or use of specific toxic chemicals. Space limitation necessitate the use of descriptive medical terms and toxicological abbreviations. A glossary and an abbreviation list were developed to define some of those sometimes unfamiliar terms and abbreviations. The page numbers are keyed to the catalog number in the chemical stores at ORNL.

53755 (ORNL/TM—6981/V3) **Materials Safety Data Sheets: the basis for control of toxic chemicals.** Ketchen, E.E.; Porter, W.E. (Oak Ridge National Lab., TN (USA)). Sep 1979. Contract W-7405-ENG-26. 476p. P 21/MF A01.

The Material Safety Data Sheets contained in this volume are the basis for the Toxic Chemical Control Program developed by the Industrial Hygiene Department, Health Division, ORNL. The three volumes are the update and expansion of ORNL/TM-5721 and ORNL/TM-5722 Material Safety Data Sheets: The Basis for Control of Toxic Chemicals, Volume I and Volume II. As such, they are a valuable adjunct to the data cards issued with specific chemicals. The chemicals are identified by name, stores catalog number where appropriate, and sequence numbers from the NIOSH Registry of Toxic Effects of Chemical Substances, 1977 Edition, if available. The data sheets were developed and compiled to aid in apprising the employees of hazards peculiar to the handling and/or use of specific toxic chemicals. Space limitation necessitate the use of descriptive medical terms and toxicological abbreviations. A glossary and an abbreviation list were developed to define some of those sometimes unfamiliar terms and abbreviations. The page numbers are keyed to the catalog number in the chemical stores at ORNL.

GEOSCIENCES

GEOLOGY AND HYDROLOGY

REFER ALSO TO CITATION(S) 52697, 52702, 53697

53756 (ORNL/TM—6818) **Bibliography of taxonomic literature for the identification of fruits, seeds, and vegetative plant fragments.** Delcourt, P.A.; Davis, O.K.; Bright, R.C. (comps.). (Oak Ridge National Lab., TN (USA)). Aug 1979. Contract W-7405-ENG-26. 90p. P 05/MF A01.

This bibliography represents a major consolidation of citations from a large volume of taxonomic literature in order to facilitate and improve identifications of Quaternary plant macrofossils.

53757 (PNL—2949) **Geohydrology and ground-water quality beneath the 300 Area, Hanford Site, Washington.** Lindberg, J.W.; Bond, F.W. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1979. Contract EY-76-C-06-1830. 165p. P 08/MF A01.

Ground water enters the 300 Area from the northwest, west, and southwest. However, throughout most of the 300 Area, the flow is to the east and southeast. Ground water flows to the northeast only in the southern portion of the 300 Area. Variations in level of the Columbia River affected the ground-water system by altering the level and shape of the 300 Area watertable. Large quantities of process waste water, when warmed during summer months by solar radiation or cooled during winter months by ambient air temperature, influenced the temperature of the ground water. Leaking pipes and the intentional discharge of waste water (or withdrawal of ground water) affected the ground-water system in the 300 Area. Water quality tests of Hanford ground water in and adjacent to the 300 Area showed that in the area of the Process Water Trenches and Sanitary Leaching Trenches, calcium, magnesium, sodium, bicarbonate, and sulfate ions are more dilute, and nitrate and chloride ions are more concentrated than in surrounding areas. Fluoride, uranium, and beta emitters are more concentrated in ground water along the bank of the Columbia River in the central and southern portions of the 300 Area and near the 340 Building. Test wells and routine groundwater sampling are adequate to point out contamination. The variable Thickness Transient (VTT) Model of ground-water flow in the unconfined aquifer underlying the 300 Area has been set up, calibrated, and verified. The Multicomponent Mass Transfer (MMT) Model of distribution of contaminants in the saturated regime under the 300 Area has been set up, calibrated, and tested.

53758 (USGS—474-305) **Complete Bouguer gravity map of the Caliente 1^0 x 2^0 sheet, Nevada and Utah.** Healey, D.L.; Wahl, R.R.; Currey, F.E.; Stephens, W.E. (Geological Survey, Denver, CO (USA)). Jul 1979. Contract EY-76-A-08-0474. 76p. P 05/MF A01.

The complete Bouger gravity anomaly map of the Caliente 1^0 x 2^0 sheet results from a compilation of 2,417 gravity stations. Data for the majority of these stations were measured by field crews from the U.S. Geological Survey. The remaining stations were obtained from the files of the Department of Defense, Gravity Services Division. These stations were obtained by the Department of Defense from various workers and organizations and widely scattered over the map. The gravity-station values were all converted to the IGSN datum, and the map was machine contoured. 1 figure, 1 table.

53759 Improving methods for determining the effective porosity of coal and rock. Schchukin, A.E. *Izv. Vyssh. Uchebn. Zaved., Gorn. Zh.;* No. 10, 84-87(1978). (In Russian).

Results are given for laboratory tests of the effective porosity of an absorbent in a capillary saturation system of water and aqueous solutions: PAA, PVS, DS, DB, NL, HCl. Relationships were identified between the effective porosity of the sorbent and concentration (pressure) of the solution for each liquid. A formula was suggested for determining the effective porosity of the sorbent which accounts for surface adsorption on a solid state—liquid border and the degree of the medium's dispersion. This makes it possible to estimate the actual volume of fluid being pumped into a well. 4 references, 1 table.

GEOPHYSICS

SEISMOLOGY AND TECTONICS

53760 (UCRL—15084) **ARMA models for earthquake ground motions.** Chang, M.K.; Kwiatkowski, J.W.; Nau, R.F.; Oliver, R.M.; Pister, K.S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1979. Contract W-7405-ENG-48. 87p. (ORC—79-1). P 05/MF A01.

Four major California earthquake records were analyzed by use of a class of discrete linear time-domain processes commonly referred to as ARMA (Autoregressive/Moving-Average) models. It was possible to analyze these different earthquakes, identify the order of the appropriate ARMA model(s), estimate parameters, and test the residuals generated by these models. It was also possible to show the connections, similarities, and differences between the traditional continuous models (with parameter estimates based on spectral analyses) and the discrete models with parameters estimated by various maximum-likelihood techniques applied to digitized acceleration data in the time domain. The methodology proposed is suitable for simulating earthquake ground motions in the time domain, and appears to be easily adapted to serve as inputs for nonlinear discrete time models of structural motions. 60 references, 19 figures, 9 tables.

VOLCANOLOGY

53761 (USGS-OFR—79-926) **Major-element geochemistry of the Silent Canyon—Black Mountain peralkaline volcanic centers, northwestern Nevada Test Site: applications to an assessment of renewed volcanism.** Crowe, B.M.; Sargent, K.A. (Geological Survey, Denver, CO (USA)). 1979. Contract EW-78-I-08-1543. 27p. P 03/MF A01.

The Silent Canyon and Black Mountain volcanic centers are located in the northern part of the Nevada Test Site. The Silent Canyon volcanic center is a buried cauldron complex of Miocene age (13 to 15 m.y.). Black Mountain volcanic center is an elliptical-shaped cauldron complex of late Miocene age. The lavas and tuffs of the two centers comprise a subalkaline-peralkaline association. Rock types range from quartz normative subalkaline trachyte and rhyolite to peralkaline commendite. The Gold Flat Member of the Thirsty Canyon Tuff (Black Mountain) is a pantellerite. The major-element geochemistry of the Black Mountain—Silent Canyon volcanic centers differ in the total range and distribution of SiO_2, contents, the degree of peralkalinity (molecular $Na_2O + K_2O > Al_2O_3$) and in the values of total iron and alumina through the range of rock types. These differences indicate that the suites were unrelated and evolved from differing magma bodies. The Black Mountain volcanic cycle represents a renewed phase of volcanism following cessation of the Timber Mountain—Silent Canyon volcanic cycles. Consequently, there is a small but numerically incalculable probability of recurrence of Black Mountain-type volcanism within the Nevada Test Site region. This represents a potential risk with respect to deep geologic storage of high-level radioactive waste at the Nevada Test Site.

GEOPHYSICAL SURVEY METHODS

53762 Resistivity modelling for arbitrarily shaped two-dimensional structures. Dey, A.; Morrison, H.F. (Univ of Calif, Lawrence Berkeley Lab). *Geophys. Prospect.;* **27**: No. 1, 106-136(Mar 1979).

A numerical technique is developed to solve the three-dimensional potential distribution about a point source of current located in or on the surface of a half-space containing arbitrary two-dimensional conductivity distribution. Finite difference equations are obtained for Poisson's equations by using point- as well as area-discretization of the subsurface. Potential distributions at all points in the set defining the half-space are simultaneously obtained for multiple point sources of current injection. The solution is obtained with direct explicit matrix inversion techniques. Accurate solutions using the area-discretization method were obtained with less attendant computational costs than with the relaxation, finite-element, or network solution techniques for models of comparable dimensions.

53763 Estimation of dip and lateral extent of beds with borehole gravimetry. Hearst, J.R. (Univ. of California, Livermore). *Geophysics;* **42**: No. 5, 990-994(Aug 1977).

Simple expressions for the estimation of dip or lateral extent of a bed whose extent is large compared to its thickness were developed. Let rho/sub CA/ be the apparent density contrast between the bed and its surroundings as measured by a borehole gravimeter and rho/sub CT/ the true density contrast measured by a gamma—gamma density log. Then for a dipping bed: rho/sub CA/ approx. = rho/sub CT/$\cos^2\alpha$, where α is the dip angle. For dipping beds of finite lateral extent the expression is more complicated. Numerical solutions were obtained and graphed.

MINERALOGY, PETROLOGY, AND ROCK MECHANICS

REFER ALSO TO CITATION(S) 52677, 52691, 52698, 52701

53764 (LA—7936-MS) **Amphiboles on the join pargasite—ferropargasite.** Charles, R.W. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 17p. P 02/MF A01.

Amphiboles were grown across the join $NaCa_2Mg_4AlSi_6Al_2O_{22}(OH)_2$—$NaCa_2Fe_4AlSi_6Al_2O_{22}(OH)_2$ on QFM and CCH_1 oxygen buffers to gain insight into the Fe—Mg substitu-

tion in an amphibole without the local charge imbalance caused by Na in the M(4) site. Oxygen fugacity was found to have no effect upon the unit cell dimensions of amphibole. Unit cell parameters for amphibole grown across the series are tabulated. No change in cell parameters was observed with temperature on a given buffer. The essentially linear trend indicates general disorder of Mg and Fe in M(1), M(2), and M(3) sites. In all cases plagioclase and pyroxene were present in the charge. The amount ranged from a few percent to greater than 30% without affecting the unit cell parameters of coexisting amphibole. 3 figures, 5 tables.

GEOCHEMISTRY

53765 (DOE/EV/00890—3) **Trace element geochemistry of the South Atlantic Bight. Progress report.** Windom, H.L.; Wallace, G.T. (Skidaway Inst. of Oceanography, Savannah, GA (USA)). 2 Mar 1979. Contract EY-76-S-09-0890. 25p. P 02/MF A01.

A general review of research results for the year ending March 1, 1979, is given. Objectives were to determine the role of frontal zones in the nearshore region on trace element transport and dispersion, to develop a better understanding of intrusion source water trace element characteristics, to continue to quantify trace element inputs to the South Atlantic Bight, and to elucidate the role of particulate matter in the geochemistry of trace elements in the South Atlantic Bight. It was found that the concentration of both particulate and total trace metals decreases sharply across the nearshore front, and rapidly approaches values found in oligotrophic open ocean surface waters. Compositional analysis of the particulate phase when combined with total metal analysis suggests that Cu may preferentially associate with particulate organic matter, even in the clay-mineral-rich, turbid nearshore zone. 5 figures, 10 tables. (RWR)

OCEANOGRAPHY

REFER ALSO TO CITATION(S) 53765

PHYSICS RESEARCH

ASTROPHYSICS AND COSMOLOGY

STARS

53766 (LA-UR—79-2044) **Time-scale for turn-off of a nova after the outburst.** Starrfield, S. (Los Alamos Scientific Lab., NM (USA); Arizona State Univ., Tempe (USA). Dept. of Physics). 1979. Contract W-7405-ENG-36. 7p. (CONF-790755—2). P 02/MF A01.

From IAU colloquium on the structure of white dwarfs and variable degenerates; Rochester, NY, USA (30 Jul 1979).

Theoretical and observational evidence is reviewed for the remnant from a nova outburst. Its evolution to burnout is described. Finally, the various physical mechanisms which can lead to an extended period of mass loss are discussed. 19 references. (JFP)

53767 (LA-UR—79-2045) **Radial pulsation analyses of DA dwarfs.** Starrfield, S.; Cox, A.N.; Hodson, S.W. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 7p. (CONF-790755—1). P 02/MF A01.

From IAU colloquium on the structure of white dwarfs and variable degenerates; Rochester, NY, USA (30 Jul 1979).

A careful study is made of realistic white dwarf envelopes with new opacities in order to identify any destabilizing mechanisms present in the models with a future application to a nonradial study. The initial results showed that the high order radial overtones were unstable. An extension is now made to various chemical compositions and slightly more realistic radii. This always shows that there is an instability strip lying at a certain temperature range depending upon the composition. The radial eigenfunctions are shown and the growth rates discussed. Also the work function integral is given. The possible mechanism and observational problems for these unstable modes are considered. 17 references. (JFP)

53768 (UCRL—81957) **Effect of boundary conditions on a non-equilibrium transient Marshak wave problem.** Alonso, C.T.; Pomraning, G.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.; California Univ., Los Angeles (USA)). 15 Jan 1979. Contract W-7405-ENG-48. 30p. (CONF-790156—1). P 03/MF A01.

From 2. topical conference on atomic processes in high temperature plasmas; Boulder, CO, USA (17 Jan 1979).

Transient processes in radiative transfer have recently become of interest in the modeling of astrophysical phenomena, particularly with regard to the brightness of novae, supernovae, and perhaps even galactic clouds adjacent to quasars. Analytic solutions to a particular class of Marshak wave problems are presented with and without the Marshak (Milne) boundary condition. The choice of boundary condition can have a decisive effect on the coupling of radiative energy to the material energy in the vicinity of a material boundary. The analytic solution obtained can be useful as a tool for calibrating numerical calculation techniques.

SOLAR PHENOMENA

53769 (LA-UR—79-1921) **Imaging x-ray spectrometer to study solar activity in conjunction with the SCADM program.** Blake, R.L. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 16p. (CONF-7906111—1). P 02/MF A01.

From Solar cycle and dynamics mission conference; Wellesley, MA, USA (14 Jun 1979).

An experiment is proposed to study solar active region dynamics and evolution. It will greatly extend the range of capabilities provided by the Solar Maximum Mission. The larger volume and weight capacity of a shuttle launch make possible an experiment with enough sensitivity to study the fastest known solar phenomena with high spatial and spectral resolution. It will be possible to use high spectral resolving power to image events on a small scale in short time intervals, and it will be possible to use this tremendous diagnostic power from the instant of event onset. Similar sensitivity will be available for the study of active region morphology and evolution. (GHT)

53770 (PB—291867) **Solar—geophysical data number 411, November 1978, Part II (Comprehensive reports). Data for May 1978, April 1978 and miscellanea.** Coffey, H.B. (National Geophysical and Solar-Terrestrial Data Center, Boulder, CO (USA)). Nov 1978. 95p. Y A05/MF A01.

This comprehensive report provides data for May 1978 on active regions, synoptic solar maps, solar flares, solar radio waves, and energetic solar particles and plasma. It also provides a synoptic chart, abbreviated calendar record, and regional flare index for April 1978. The miscellaneous data includes solar x-ray radiation, cosmic rays, solar radio waves, geomagnetic indices, and energetic solar particles and plasma.

ATMOSPHERIC PHYSICS

EFFECTS OF NUCLEAR DETONATIONS

53771 (AD-A—061461) **A gradient drift microstructure model. Topical report, 1 November 1975-28 February 1978.** Workman, J.B.; Chu, S.Y.F. Feb 1978. Contract DNA001-76-C-0136. 81p. Y A05/MF A01.

An approximate theoretical and numerical model for gradient drift microstructure has been developed. While it is believed to be completely consistent with all current theoretical understanding of the physics, the model is quite flexible and adjustable so as to provide agreement with the experimental data base. Capable of spanning many orders of magnitude in scale size, the model provides the mechanics of cascade and ultimate diffusion required for late time studies. (Author)

MAGNETOSPHERIC PHENOMENA

REFER ALSO TO CITATION(S) 53770

53772 (UCRL—52807) **Study of energetic electrons in the outer radiation-belt regions using data obtained by the LLL spectrometer on OGO-5 in 1968.** West, H.I. Jr.; Buck, R.M.; Davidson, G. (California Univ., Livermore (USA). Lawrence Livermore Lab.; Lockheed Palo Alto Research Labs., CA (USA)). 26 Jul 1979. Contract W-7405-ENG-48. 84p. P 05/MF A01.

An account is given of measurements of electrons made by the LLL magnetic electron spectrometer (60 to 3000 keV in seven differential energy channels) on the Ogo-5 satellite in the earth's outer-belt regions during 1968 and early 1969. The data were analyzed specifically to determine pitch-angle diffusion lifetimes as a function of energy in the L-range 2 to 5. As a part of this effort, the general dynamics of these regions were studied in terms of the time-dependent energy spectra, and pitch-angle distributions for the seven energy groups were obtained as a function of L with representative values presented for L = 2.5 to 6. The pitch-angle-diffusion results were used to analyze the dynamics of the electrons injected following the intense storms on October 31 and November 1, 1968, in terms of radial diffusion; the derived diffusion coefficients provide a quite reasonable picture of electron transport in the radiation belts. Both the radial- and pitch-angle-diffusion results are compared with earlier results. 53 references.

ATOMIC, MOLECULAR, AND CHEMICAL PHYSICS

REFER ALSO TO CITATION(S) 53816

53773 (LA-UR—79-1913) **High resolution saturation spectroscopy with CO_2 lasers. Application to the ν_3 bands of SF_6 and OsO_4.** Borde, C.J.; Ouhayoun, M.; Van Lerberghe, A.; Salomon, C.; Avrillier, S.; Cantrell, C.D.; Borde, J. (Paris-13 Univ., 93 - Saint-Denis (France); Los Alamos Scientific Lab., NM (USA); Chicago Univ., IL (USA); Paris-11 Univ., 91 - Orsay (France)). 1979. Contract W-7405-ENG-36. 14p. (CONF-790690—2). P 02/MF A01.

From 4. international conference on laser spectroscopy; Rottach-Egern, Tegernsee, F.R. Germany (11 Jun 1979).

Topics covered include: the frequency-controlled saturation spectrometer; application to the rotational fine structure of the ν_3 band of $^{32}SF_6$ and determination of a new set of spectroscopic parameters; magnetic hyperfine structure of the SF_6 lines, evidence for a spin-vibration interaction; direct optical observation of the ground state octahedral splittings of SF_6 and violation of the $\Delta C = O$ selection rule; and fine and hyperfine structure studies in the ν_3 band of OsO_4. (GHT)

53774 **Structure and collisions of ions and atoms.** Sellin, I.A. (ed.). New York, NY; Springer-Verlag (1978). 360p.

Separate abstracts were prepared for the eight papers presented. (JFP)

BEAMS AND THEIR REACTIONS

53775 (COO—4974-1) **Interactions of molecules with surfaces. Progress report, August 1, 1978—April 30, 1979.** Greene, E.F. (Brown Univ., Providence, RI (USA)). Apr 1979. Contract ER-78-S-02-4974. 13p. P 02/MF A01.

An apparatus is being set up to measure the elastic scattering of a velocity selected beam of Kr atoms from the surface of a graphite crystal. The angular distribution and energy dependence of the scattering will be compared with the predictions of a simple model to learn about the nature of the surface. The yields of positive ions produced when beams of neutral alkali atoms hit hot surfaces of silicon or alumina have been measured for various temperatures of the surfaces. A quasi-equilibrium model for the ionization fits the results for Si well but is inadequate in the case of Al_2O_3. In the latter case the ion yield is increased somewhat in the presence of visibe radiation, and some of the dynamics of the ionization process may be measurable. Decomposition and polymerization reactions are found to occur when molecules of high kinetic energies are suddenly stopped by hitting a surface. The yields of products depend on the internal as well as the kinetic energy. Beams of CCl_4, C_2Cl_6 and trioxane have been studied.

53776 (GEPP-TIS—443) **Obtaining numerical values for the elliptic emission functions used in calculating electron emission from surfaces.** Miller, H.C. (General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.). 7 Sep 1979. Contract EY-76-C-04-0656. 37p. P 03/MF A01.

The four elliptic emission functions v(y), t(y), s(y) and θ(y) [or f/sub mg/(y)] are used in calculating electron emission from surfaces under the influence of temperature and external electric fields. Critical evaluations are made of the published tables of these functions. Several existing approximation equations for the emission functions are given together with some additional polynomial approximations. The estimated accuracies of these approximation equations range from five to six significant figures for the most complex approximations to +-1% or so for the simplest.

53777 **Crystallographic anisotropy in the decay of surface plasmons to photoelectrons.** Furtak, T.E.; Sass, J.K. (Ames Lab., IA (USA)). *Surf. Sci.;* **78**: No. 3, 591-597(Dec 1978).

A combined photoemission and electroreflectance investigation has been performed on Ag(111) and Ag(100) in contact with an electrolyte. The optical excitation of surface plasmons was induced on both faces by electrochemically roughening the sample surfaces. Electron emission, as a result of surface plasmon excitation, was observed only on Ag(111) and not on Ag(100). This striking crystallographic anisotropy in surface plasmon decay is attributed to the difference in efficiency of excited electron transmission on both faces.

53778 **Conditions for total reflection of low-energy atoms from crystal surfaces.** Hou, M. (Brussels Univ. (Belgium)); Robinson, M.T. (Oak Ridge National Lab., TN (USA)). *Appl. Phys.;* **17**: No. 4, 371-375(Dec 1978).

The critical angles for the total reflection of low-energy particles from Cu < 100 > rows and (001) planes have been investigated, using the binary collision approximation computer simulation code MARLOWE Breakthrough angles were evaluated for H, N, Ne, Ar, Cu, Xe, and Au in the energy range from 0.1 to 7.5 keV. In both the axial and the planar cases, recoiling of the target atoms lowers the energy barrier which the target surface presents to the heavy projectiles. Consequently, the breakthrough angles are reduced for heavy projectiles below the values expected either from observations on light projectiles or from analytical channeling theory.

53779 **Extensions of beam foil spectroscopy.** Sellin, I.A. pp 273-307 of Structure and collisions of ions and atoms. Sellin, I.A. (ed.). New York, NY; Springer-Verlag (1978).

The discussion and review of beam—foil spectroscopy includes the extension of the dynamic range of lifetime measurements using the beam—foil technique, target ion recoil spectroscopy, and projectile electron spectroscopy. 50 references. (JFP)

ATOMIC AND MOLECULAR PROPERTIES

REFER ALSO TO CITATION(S) 53789

53780 (ANL—78-66, pp 212-214) **High-resolution spectroscopy of atomic beams with tunable lasers and radiofrequency techniques.** Childs, W.J.; Goodman, L.S.; Poulsen, O. 1978.

In Physics Division annual review, 1 April 1977—31 March 1978.

The rf-laser double-resonance technique was applied to an atomic beam of Sm. Fluorescence obtained from a collimated beam by scanning a monochromatic laser in the region of 5868.60 A is shown. The hyperfine structure of the odd-A isotopes ^{147}Sm and ^{149}Sm and the isotope shifts of all seven naturally occurring isotopes can be seen. The linewidth is about 4 MHz. Rf-laser double resonance in the metastable $4f^6 5d6s\ ^9H_2$ state of Sm at 11044.90 cm^{-1} is also shown. The precision is about 1000 times better than that achievable by customary laser fluorescence techniques alone. 2 figures. (RWR)

53781 (CALT—63-305) **Dependence of the K x-ray energy on the mode of excitation.** Wang, K.C.; Boehm, F.; Hahn, A.A.; Vogel, P. (California Inst. of Tech., Pasadena (USA)). 1977. Contract EY-76-C-03-0063. 8p. P 02/MF A01.

The energy shifts in the Ta K x rays resulting from the K-capture of ^{181}W, fluorescence of Ta, and β^- decay of ^{181}Hf followed by internal conversion in ^{181}Ta are reported. Both W metal and WO_3 on one hand, and Ta metal and Ta_2O_5 on the other hand, were used. Comparison of the K x-ray energies of the K-capture sources ^{153}Gd (Eu x rays) and ^{175}Hf (Lu x rays) and the corresponding fluorescence sources was also made. Various effects which may influence the K x-ray energies are discussed. 9 references. (EB)

53782 (COO—1198-1270) **High pressure luminescence studies.** Drickamer, H.G. (Illinois Univ., Urbana (USA)). 1979. Contract EY-76-C-02-1198. 7p. (CONF-790709—15). P 02/MF A01.

From VII international AIRAPT conference; La Creusot, France (30 Jul 1979).

High pressure luminescence studies have proven very powerful in characterizing electronic states and excitations and in testing theories. Examples are given related to physics, chemistry and biology. The first problem treated concerns tests of a model for the Jahn-Teller effect involving heavy metal ions in alkali halides. This is a problem in solid state physics. The second problem relates to both inorganic chemistry and solid state physics. We discuss the luminescence efficiency if Eu^{+3} in the La_2O_2S lattice. These phosphors are important technologically. The next two problems arise in physical-organic chemistry. One involves the effect of viscosity on luminescence efficiency of dye molecules, with possible interactions. The other concerns singlet-triplet interactions in aromatic molecules. The final problem has implictions for protein chemistry as well as for the solution chemistry of organic molecules in aqueous solutions. It concerns the covalent interaction of ligands with polymeric substrates.

53783 **Variational calculations of resonant states of H_2^-.** Bardsley, J.N.; Cohen, J.S. (Los Alamos Scientific Lab., NM (USA)). *J. Phys., B (London);* **11**: No. 21, 3645-3654(14 Nov 1978).

Variational calculations of several excited states of H_2^- are reported. The structure observed in e-H_2 scattering around 11.5 eV is attributed to $^2\Sigma$sub(g)$^+$ and ^{2}PIsub(u) resonances. Further evidence is provided that the predissociation of the $^2\Sigma$sub(g)$^+$ states causes the oscillations in the dissociative attachment cross section observed near 12 eV. The lowest $^2\Delta$sub(g) resonance is found to be near 11.7 eV.

COLLISION PHENOMENA

REFER ALSO TO CITATION(S) 53953

53784 (ANL—78-66, pp 178-179) **Dissociation of fast HeH^+ ions in foils and gases.** Gemmell, D.S.; Cooney, P.J.; Pietsch, W.J.; Ratkowski, A.J.; Vager, Z. 1978.

In Physics Division annual review, 1 April 1977—31 March 1978.

To gain understanding of phenomena observed when very simple light diatomic ions are incident at high velocities upon thin foils and gaseous targets, an extensive set of measurements on the dissociation products arising from beams of HeH^+ was made. Experimental and calculated joint distributions in energy and angle for protons emerging (near the beam direction) from an 85-A carbon foil bombarded by 2.0-MeV HeH^+ ions are presented.

53785 (CONF-790658—6) **Angular distributions in molecular ion dissociations observed by photoelectron-photoion coincidence spectroscopy.** Eland, J.H.D. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 3p. P 02/MF A01.

From 27. annual conference on mass spectrometry and allied topics; Seattle, WA, USA (3 Jun 1979).

Angular distributions from molecular ion dissociation found previously to be anisotropic, demonstrating that the decay lifetimes are there shorter than the rotation periods, give the expectation that the majority of fast molecular ion dissociations will show angular anisotropies when examined by the coincidence method. 1 reference. (JFP)

53786 (LA-UR—79-2070) **Laser excitation of SF_6: spectroscopy and coherent pulse propagation effects.** Cantrell, C.D.; Makarov, A.A.; Louisell, W.H. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 68p. P 04/MF A01.

Recent theoretical studies of coherent propagation effects in SF_6 and other polyatomic molecules are summarized beginning with an account of relevant aspects of the high-resolution spectroscopy of the ν_3 band of SF_6. A laser pulse propagating in a molecular gas can acquire new frequencies which were not initially present in the pulse, and, in fact, a wave is coherently generated at the frequency of every molecular transition accessible from the initial molecular energy levels. The possible consequences of coherent generation of sidebands for the multiple-photon excitation of SF_6 and other polyatomic molecules are discussed.

53787 (SAND—79-0712) **^{3}He and ^{20}Ne classical atomic scattering cross sections for θ/sub Lab/ = 90° and 138° using the moliere approximation of the Thomas-Fermi potential.** Nelson, G.C. (Sandia Labs., Albuquerque, NM (USA)). Jun 1979. Contract W-7405-ENG-48. 21p. P 02/MF A01.

The Moliere approximation to the Thomas-Fermi screening function was used in a screened Coulomb potential to calculate tables of differential scattering cross sections for laboratory scattering angles of 90 and 138°. Data are provided for incident ions of $^3He^+$ and $^{20}Ne^+$ as a function of energy (0.05 to 5.0 keV) and target atom. 3 references.

53788 (UCRL—15046) **Some features of Rayleigh scattering from light atoms and ions.** Parker, J.C.; Pratt, R.H. (Pittsburgh Univ., PA (USA). Dept. of Physics and Astronomy). 18 Jul 1979. Contract W-7405-ENG-48. 41p. P 03/MF A01.

When photon energies are well below 1 MeV the only significant contribution to elastic (coherent) photon-atom scattering comes from Rayleigh scattering, the elastic scattering of photons from bound atomic electrons. This report discusses the Rayleigh scattering cross sections for atoms and ions of low nuclear charge, particularly for photon energies in the vicinity of the threshold for photoionization from the K-shell. Just below this threshold energy there is a sequence of resonances in the elastic scattering amplitude. Each resonance occurs at an energy corresponding to the excitation of a K-shell electron to a higher unfilled shell. For a multi-electron atom the total cross section can go through a near zero minimum just below the resonance region due to interference between K and L amplitudes. The resonance region expands with increasing ionization, on the low side as more interior shells become unfilled and accessible, and, on the high side as the ionization threshold increases. Above the ionization threshold, in an isonuclear sequence the K-shell amplitudes share a common curve differing only in the position of the threshold. When the K-shell is opened the amplitude departs from this common curve. Above, but near, threshold the imaginary part of the K-shell amplitude is important but it rapidly decreases. Well above the threshold form factor predictions are approached for the atom and for the scattering from each subshell separately.

53789 **Collisional energy dependence of T-R and T-V energy transfer between $Ar^*(^3P)$ and $CO_2(X^1\Sigma^+$/sub g)/.** Manzanares, E.R.; Gentley, J.; Winicur, D.H. (Notre Dame Univ., IN (USA). Radiation Lab.). *Chem. Phys. Lett.;* **60**: No. 1, 73-76(15 Dec 1978).

The collisional-energy dependence of the fraction of the collision energy transferred to $CO_2(X^1\Sigma^+$/sub g/) rotation from $Ar^*(^3P)$ was measured by use of crossed-molecular beams between 5 and 184 meV. A discontinuity observed at 70 meV indicates the presence of vibrational excitation.

53790 **Assignment of rate constants to exit channels from quenching of He(2^3S) metastable atoms.** Chang, R.S.F.; Setser, D.W. (Kansas State Univ., Manhattan (USA). Dept. of Chemistry); Taylor, G.W. (Los Alamos Scientific Lab., NM (USA)). *Chem. Phys. (Amsterdam);* **35**: No. 1, 201-214(1 Dec 1978).

The reaction of He(2^3S) with N_2 and CO have been used as reference reactions for assignment of rate constants to exit channels for quenching of He(2^3S) by reagents that gives products which subsequently emit radiation. The method involves comparison of relative emission intensities from $N_2^+(B\text{-}X)$ or $CO^+(B\text{-}X)$ to the emission intensities from products generated from other reagents. This comparison method is useful for an extended wavelength range; in the present work emissions from 140-800 nm have been observed in studying O_2, NO, a series of hydrocarbons, hexafluorobenzene and pentafluorobenzene.

53791 **Dissociative recombination of large molecular ions.** Bottcher, C. (Oak Ridge National Lab., TN (USA)). *J. Phys., B (London);* **11**: No. 22, 3887-3898(28 Nov 1978).

The theory of indirect dissociative recombination (which occurs through the excitation of rotational or vibrational degrees of freedom in the molecular ion) is developed in order to explain the very large rates measured for the recombination of poly-atomic molecular ions. Theoretical upper bounds on the rates are established. The formulation simplifies considerably for loosely-bound aggregates, and it is thus possible to explain the dependence upon n of the observed rates for H_30^+ (H_20)sub n.

53792 **Production of krypton L vacancies in Kr-Kr and Kr-Xe collisions.** Fortner, R.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.); Woerlee, P.; Saris, F.W. *J. Phys., B (London);* **11**: No. 22, L697-L701(28 Nov 1978).

The x-ray production cross sections for the krypton L shell in Kr-Kr and Kr-Xe collisions are reported. The cross sections exhibit an energy dependence characteristic of 'triple-peak' structures in rapidly promoted $4f^+$ molecular orbitals. The data suggest that in these collision systems for distances of closest approach less than about 0.1×10^{10}m the probability of producing two L-shell vacancies is unity.

ATOMIC AND MOLECULAR THEORY

53793 (COO—3127-30-T1) **Approximation methods for the partition functions of anharmonic systems.** Lew, P.; Ishida, T. (Brooklyn Coll., NY (USA). Dept. of Chemistry). Jul 1979. Contract EY-76-S-02-3127. 132p. P 07/MF A01.

Thesis.

The analytical approximations for the classical, quantum mechanical and reduced partition functions of the diatomic molecule oscillating internally under the influence of the Morse potential have been derived and their convergences have been tested numerically. This successful analytical method is used in the treatment of anharmonic systems. Using Schwinger perturbation method in the framework of second quantization formulism, the reduced partition function of polyatomic systems can be put into an expression which consists separately of contributions from the harmonic terms, Morse potential correction terms and interaction terms due to the off-diagonal potential coefficients. The calculated results of the reduced partition function from the approximation method on the 2-D and 3-D model systems agree well with the numerical exact calculations.

53794 **Nuclear radiation as a probe of chemical bonding. The current interplay between theory and experiment.** Newton, M.D. (Brookhaven National Lab., Upton, NY (USA)). *At. Energy Rev.;* **17**: No. 2, 237-285(Jun 1979).

After a survey of appropriate theoretical formalisms, recent confrontations of theory and experiment in the areas of neutron scattering, Moessbauer spectroscopy and positron chemistry are discussed, with major emphasis on the degree to which simple concepts of chemical bonding can be refined by complementary use of the above experimental probes and the powerful techniques of computational quantum chemistry.

53795 **Lifetime of the Xe II $5s5p^6$ ^{2}sub(1/2) state.** Rosenberg, R.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.); White, M.G.; Poliakoff, E.D.; Thornton, G.; Shriley, D.A. *J. Phys., B (London);* **11**: No. 23, L719-L722(14 Dec 1978).

Synchrotron radiation affords the possibility of lifetime measurements of excited ionic states following their selective excitation. This method has been used to determine the lifetime of the Xe II $5s5p^6$ ^{2}Ssub(1/2) state as 34.4(6) ns. Multiconfiguration Hartree-Fock calculations yield a value of 9.5 ns, indicating the importance of relativistic effects in such a system.

53796 **Relativistic effects in highly ionized atoms.** Armstrong, L. Jr. pp 69-103 of Structure and collisions of ions and atoms. Sellin, I.A. (ed.). New York, NY; Springer-Verlag (1978).

An investigation is made of how relativity manifests itself in highly ionized atoms. Its effects are studied on both atomic structure and transition probabilities. The emphasis is on providing all the pertinent concepts and equations necessary for a basic understanding

of the subject. Relativistic effects in highly ionized atoms, interactions in atoms, transition operators, calculation of wave functions and energies and some of the calculations that indicate the importance of relativistic effects in atomic structure are covered. 100 references. (JFP)

GENERAL FLUID DYNAMICS

REFER ALSO TO CITATION(S) 53422, 53876

53797 (LA—7955-MS) **Alternate interpretation of the subgrid scale eddy viscosity.** Ramshaw, J.D. (Los Alamos Scientific Lab., NM (USA)). Aug 1979. Contract W-7405-ENG-36. 4p. P 02/MF A01.

It is shown that the subgrid scale (SGS) eddy viscosity for numerical calculations of turbulent flow has the effect of artificially enlarging the Kolmogorov microscale until it becomes comparable to the finite-difference mesh spacing. The SGS eddy viscosity is therefore closely analogous to the von Neumann—Richtmyer artificial viscosity for shock waves.

HIGH ENERGY PHYSICS

53798 (COO—1545-253) **Four-year summary of the research effort of the High Energy Physics Group at the Ohio State University, 1973—1977.** (Ohio State Univ. Research Foundation, Columbus (USA)). 1978. Contract EY-76-C-02-1545. 36p. P 03/MF A01.

Experimental and theoretical high energy physics is summarized. Lists of proposed experiments and publications are included. (JFP)

53799 (COO—2232B-172) **Report of technical progress under the current DOE contract, EY-76-C-02-2232. *000B. Progress report, February 1, 1978—February 1, 1979.** Beg, M.A.B.; Khuri, N.N.; Pais, A. (Rockefeller Univ., New York (USA)). 1979. Contract EY-76-C-02-2232. 30p. P 03/MF A01.

Research in theoretical and experimental high energy physics is summarized. A list of publications is included. (JFP)

PARTICLE INTERACTIONS AND PROPERTIES - EXPERIMENTAL

REFER ALSO TO CITATION(S) 53816

WEAK INTERACTIONS

53800 (COO—1195-411) **Hadron production in high energy muon scattering.** Hicks, R.G. (Illinois Univ., Urbana (USA). Dept. of Physics). 1978. Contract EY-76-C-02-1195. 289p. P 13/MF A01.

Thesis.

An experiment was performed to study muon-proton scattering at an incident energy of 225 GeV and a total effective flux of 4.3 x 10^{10} muons. This experiment is able to detect charged particles in coincidence with the scattered muon in the forward hemisphere, and results are reported for the neutral strange particles K/sub s/^{0} and Λ^0 decaying into two charged particles. Within experimental limits the masses and lifetimes of these particles are consistent with previous measurements. The distribution of hadrons produced in muon scattering is determined, measuring momentum components parallel and transverse to the virtual photon direction, and these distributions are compared to other high energy experiments involving the scattering of pions, protons, and neutrinos from protons. Structure functions for hadron production and particle ratios are calculated. No azimuthal dependence is observed, and lambda production does not appear to be polarized. The physical significance of the results is discussed within the framework of the quark-parton model. 29 references.

53801 (COO—3071-240) **Comparison of neutrino data on average values of structure function and quark-parton model parameters.** Mann, A.K. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). 1979. Contract EY-76-C-02-3071. 22p. (CONF-790365—7). P 02/MF A01.

From 16. rencontre de moriond; Les Arcs, Savoie, France (17 Mar 1979).

A brief survey of inelastic neutrino and antineutrino interactions is presented which exhibits the growing internal consistency of the experimental data on structure function and QPM parameters averaged over the energy interval from about 20 to 200 GeV, and is in excellent agreement with expectations based on the QPM. 10 references.

STRONG BARYON-INDUCED INTERACTIONS

REFER ALSO TO CITATION(S) 53800, 53857

53802 (BNL—26483) **Confirmation of the existence of the Σ/sub c/$^{++}$ and Λ/sub c/$^+$ charmed baryons.** Baltay, C.; Caroumbalis, D.; French, H. (Columbia Univ., New York (USA); Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 8p. (CONF-790648—5). P 02/MF A01.

From Neutrino 1979 conference; Bergen, Norway (18 Jun 1979).

In a broad-band neutrino exposure of the Fermilab 15-ft. bubble chamber, the production of the Σ/sub c/$^{++}$(2426) charmed baryon followed by its decay to Λ/sub /c$^+$(2260) and π^+ was observed. The mass of the Λ/sub c/$^+$ was found to be (2257 +- 10) MeV and the m(Σ/sub c/$^{++}$) - m(Λ/sub c/$^+$) mass difference to be (168 +- 3) MeV. Previously unseen two body decay modes of the Λ/sub c/$^+$(2260) are observed. 15 references.

53803 (BNL—26547) **Projectile rapidity dependence in target fragmentation.** Haustein, P.E.; Cumming, J.B.; Hseuh, H.C. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 28p. (CONF-790743—4). P 03/MF A01.

From Symposium on heavy ion physics from 10-200 MeV/A; Upton, NY, USA (16 Jul 1979).

The thick-target, thick-catcher technique was used to determine mean kinetic properties of selected products of the fragmentation of Cu by ^{1}H, ^{4}He, and ^{12}C ions (180 to 28,000 MeV/amu). Momentum transfer, as inferred from F/B ratios, is ovserved to occur most efficiently for the lower velocity projectiles. Recoil properties of target fragments vary strongly with product mass, but show only a weak dependence on projectile type. The projectile's rapidity is shown to be a useful variable for quantitative intercomparison of different reactions. These results indicate that E/sub proj//A/sub proj/ is the dominant parameter which governs the mean recoil behavior of target fragments. 20 references.

53804 (COO—3071-241) **Recent results from a high Pt jet experiment at Fermilab.** Cormell, L.; Corcoran, M.; Dris, M. (Pennsylvania Univ., Philadelphia (USA)). Apr 1979. Contract EY-76-C-02-3071. 18p. (CONF-790484—2). P 02/MF A01.

From American Physical Society meeting; Washington, DC, USA (23 Apr 1979).

Some recent results from a two-arm calorimeter experiment performed at Fermilab are presented. The properties of high P/sub t/ jets produced in hydrogen from incident pions and protons were studied. These studies lead to several important results: the high P/sub t/ jet events observed are produced by parton—parton (quark or gluon) scattering, and therefore: an effective parton structure function for the pion and the internal transverse momentum of these partons could be measured. 16 references.

STRONG MESON-INDUCED INTERACTIONS

REFER ALSO TO CITATION(S) 53800, 53804

53805 (COO—1195-443) **Study of Zweig's rule using phi mesons in a broad band neutral beam.** Goodman, M.C. (Illinois Univ., Urbana (USA). Dept. of Physics). 1979. Contract EY-76-C-02-1195. 128p. P 07/MF A01.

Thesis.

A study of Zweig's rule using phi mesons in a high energy photon beam was performed. Measurement of the ratio $\sigma(\gamma A \rightarrow \text{phi } \pi\pi A)/\sigma(\gamma A \rightarrow \omega\pi\pi A) = 0.10 +- 0.02$ is taken as evidence that there is not as strong suppression as could be expected. Other ratios show strange particle production down from nonstrange particle production by a factor of twelve. Decays involving phi mesons are studied, and the only candidate seen is a four sigma effect in the mode two phis with a mass 2.15 GeV. F meson, charm pseudo-scalar meson and exotic vector mesons which might decay into phis are not seen. The phi prime is not seen with an upper limit $\sigma(\gamma A \rightarrow$ phi'A)B(phi' ~

PARTICLE INTERACTIONS AND PROPERTIES - THEORETICAL

STRONG INTERACTIONS, GENERAL

53806 (CONF-790847—2) **Heavy quark—antiquark bound states in the framework of quantum chromodynamics.** Viollier, R.D.; Rafelski, J. (Massachusetts Inst. of Tech., Cambridge (USA). Center for Theoretical Physics; European Organization for Nuclear Research, Geneva (Switzerland)). Jun 1979. Contract EY-76-C-02-3069. 35p. P 03/MF A01.

From International conference on high energy physics and nuclear structure; Vancouver, Canada (13 Aug 1979).

Based on the first order running coupling constant α/sub Λ/(q^2) a quark-antiquark potential is derived in the static limit. The tachyon pole in α/sub Λ/(q^2) leads to a partially confining potential, while the smooth remainder gives rise to a Coulomb like interaction. Linear confinement is imposed by extrapolating the confining potential linearly for distances $r > r_0$. Thus, aside from the quark masses, m/sub c/ and m/sub b/, the model contains two free parameters: the renormalization mass Λ, and the extrapolation radius r_0. With Λ = 441 MeV, r_0 = .378 fm, m/sub c/ = 1.525 GeV, and m/sub b/ = 4.929 GeV the observed orthocharmonium and orthobottomium spectrum are reproduced very well. This can be viewed as evidence for the validity of the framework of quantum chromodynamics. 32 references.

53807 (COO—881-96) **Hadron collider's guide to the properties and signatures of heavy quarks.** Pakvasa, S.; Dechantsreiter, M.; Halzen, F.; Scott, D.M. (Hawaii Univ., Honolulu (USA). Dept. of Physics; Wisconsin Univ., Madison (USA). Dept. of Physics). Jul 1979. Contract EY-76-C-03-0511. 35p. (UH—511-349-79). P 03/MF A01.

Recent theoretical speculation concerning the mass of the t-quark, the charge 2/3 partner of the quark bound in Y, put it, as well as possible heavier doublets, outside the reach of existing e^+e^- machines. If correct, hadron colliders will provide the only means of studying new flavors in the near future. A study is made of the properties of heavy quarks and their bound states, emphasizing the importance of weak effects when 2M/sub q/ $\geq$ M/sub Z/ (mass of the intermediate boson); their various experimental signatures in hadronic collisions. Contrary to what one might suspect from past experience with charmed particles, it is anticipated that the associated production (and not the e^+e^- or $\mu^+\mu^-$ invariant mass of the quark-antiquark bound state) will provide the most prominent signature via the study of anomalous eμ events. It is expected that the background to any leptonic signature is severe, suggesting the requirement of simultaneous detection of hadrons. 40 references.

53808 (COO—1764-353) **String flip-flop and quark matter.** Miyazawa, H. (Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy). [nd]. Contract EY-76-C-02-1764. 23p. P 02/MF A01.

Quarks are bound by strings attached to them. When two strings come close, a rearrangement of connections takes place. This effect plays an important role in a dense ensemble of quarks, quark matter. A phase transition from nuclear matter to quark matter occurs at the nucleon density rho $<$ 5 rho_0 where rho_0 is the density of the ordinary nuclear matter. The string flip-flop causes a new type of attractive interaction between hadrons at short distances or among quarks at high density. This interaction can produce multi-quark bound states such as dibaryon or dimeson resonant states. 8 references.

STRONG INTERACTIONS, BARYON NO.=0

53809 (IS-T—861) **Bilocal field theory and a model for meson spectroscopy. Part I. Trident production by high energy charged particles on nuclei. Part II.** Mita, K. (Ames Lab., IA (USA)). May 1979. Contract W-7405-ENG-82. 135p. P 07/MF A01.

Thesis.

Bilocal field theory for quark confinement is considered in a combination of bilocal field theory with the covariant harmonic oscillator quark model. The formalism can be viewed as a direct generalization of local Lagrangian field theory. Following the usual local theory, the variational principle is used to find the Euler - Lagrange equation for the bilocal field. For a special class of Lagrangian densities satisfying a boundary condition on the hypersurface of the internal domain which is called the cell, the Euler - Lagrange equation appears to be a simple generalization of the local equation. For such Lagrangian densities there exist proper conservation laws of energy and angular momentum. The Lagrangian density with an internal covariant harmonic oscillator interaction is then introduced to describe the static properties of the mesons. Calculations of trident production by high energy charged particles on nuclei were done in the framework of covariant perturbation theory. The dominant contribution to the cross section comes from the lowest order diagrams and the higher order radiative corrections yield a very small part. The lowest order calculations are described in detail for pair production by charged bosons, in particular by π^-, following a previous approach. Cross section formulae for the fermion primary, which is taken to be the proton for concreteness, are also presented. For the high energy lepton pairs, the second-order process dominates over the first-order process. The interference term between the first and second-order process is shown to vanish. An attempt is made to calculate the radiative corrections to the second-order process. 109 references. (JFP)

STRONG INTERACTIONS, BARYON NO. GREATER THAN 1

REFER ALSO TO CITATION(S) 53819, 53857

53810 (COO—1167-42) **Nuclear chemistry research. Final report.** Sugarman, N. (Chicago Univ., IL (USA). Enrico Fermi Inst.). 1979. Contract EY-76-S-02-1167. 20p. P 02/MF A01.

Research on the mechanism by which a radioactive nucleus is produced from the interaction of a projectile with a complex nucleus in terms of the primary interaction of the projectile with a nucleon or cluster of nucleons is summarized. A list of major accomplishments and one of publications are included. (JFP)

53811 (ORO—5223-12) **Nucleon-nucleon scattering phase shifts.** Bryan, R. (Texas A and M Univ., College Station (USA). Dept. of Physics). 1978. Contract EY-76-S-05-5223. 19p. (CONF-780833—7). P 02/MF A01.

From Conference on few body systems and nuclear forces; Graz, Austria (24 Aug 1978).

Here are presented 0 to 800 MeV nucleon-nucleon elastic and inelastic phase parameters derived by several groups: Arndt and Roper; Hoshizaki; Bugg; Bystricky, Lechanoine, and Lehar; and Bryan, Clark, and VerWest. Resonant-like behavior appears in the $^1D_2$ and $^3F_3$ states above the inelastic threshold in Hoshizaki's analysis but not in Arndt and Roper's. The np data are inadequate to permit determination of the I = O phase parameters above 600 MeV. 27 references.

PARTICLE INVARIANCE PRINCIPLES AND SYMMETRIES

APPLICATIONS TO STRONG INTERACTIONS

53812 (LA-UR—79-2046) **Search for parity-violating contributions to scattering of hadrons.** Ziskind, J.; Yuan, V.; Mischke, R. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 12p. (CONF-790847—1). P 02/MF A01.

From International conference on high energy physics and nuclear structure; Vancouver, Canada (13 Aug 1979).

The study of parity violation is, at present, the only means of studying the weak nonleptonic strangness conserving nucleon-nucleon force at medium energies. The experiment is a search for parity nonconservation in p-nucleus scattering by observing a change in the total cross section as the helicity of the incident protons is reversed. A nonvanishing helicity dependent cross section, A = (σ/sub +/ - σ/sub -//σ/sub +/ + σ/sub -/) would imply the presence of a parity-violating interaction. The experiment utilized the 800-MeV longitudinally polarized external proton beam at the Clinton P. Anderson Meson Physics Facility of the Los Alamos Scientific Laboratory. The result of the most recent run, March 1979, is as follows: no parity violation is observed: A = -2.5 +- 3.2 x 10^{-6}. The systematic error contributions are not greater than 0.5 x 10^{-6}. 2 references.

FIELD THEORY

REFER ALSO TO CITATION(S) 53806, 53809

53813 (COO—3069-655) **Bifurcation and stability in Yang-Mills theory with sources.** Jackiw, R. (Massachusetts Inst. of Tech., Cambridge (USA)). Jun 1979. Contract EY-76-C-02-3069. 48p. P 03/MF A01.

A lecture is presented in which some recent work on solutions to classical Yang-Mills theory is discussed. The investigations summarized include the field equations with static, external sources. A pattern allowing a comprehensive description of the solutions and stability in dynamical systems are covered. A list of open questions and problems for further research is given. 20 references. (JFP)

53814 (COO—4742-1) **Integrability conditions for the existence of a Lagrangian in Newtonian mechanics and field theory. Annual progress report, March 1, 1978-May 31, 1979.** Sternberg, S.; Santilli, R.M. (Harvard Univ., Cambridge, MA (USA). Science Center). 1979. Contract ER-78-S-02-4742. 18p. P 02/MF A01.

Studies of general covariance and its application to particle motion and continuum mechanics were continued. Also developed was a new method in microlocal analysis which has applications to integral geometry, geometrical quantization and the fine structure of certain types of spectra. The classical aspect of a program was studied by a comprehensive analysis of the integrability conditions for the existence of a Lagrangian or, independently, of a Hamiltonian for the representation of given Newtonian systems with forces nonderivable from a potential, as well as the methods for the computation of these functions from the equations of motion. T

study of a classical, complementary, methodological approach to the same class of systems was also initiated. It consists of the representation of systems with forces nonderivable from a potential via a generalization of Hamilton's equations posessing a Lie-admissible algebraic structure. The problem of the quantization of forces nonderivable from a potential was then studied via the use of these complementary methods. The use of the integrability conditions for the existence of a Hamiltonian representation (the inverse problem) yielded, under certain restrictions, the conventional Heisenberg's equations, but expressed in terms of a generalized Hamiltonian structure. The use of the Lie-admissible formulations yielded a generalization of Heisenberg's equations possessing a generalized (Lie-admissible) algebraic structure, but expressed in terms of a conventional Hamiltonian structure. These preliminary studies were then applied to the investigation of the old idea that the strong interactions are of the type considered, local and nonderivable from a potential, as an approximation of expected nonlocal settings. The experimental verification of the validity or invalidity of Pauli's exclusion principle and other basic physical laws for the nuclear and the hadronic structure was proposed. A list of publications is included.

53815 **Quantum electrodynamics in strong and supercritical fields.** Brodsky, S.J.; Mohr, P.J. pp 3-67 of Structure and collisions of ions and atoms. Sellin, I.A. (ed.). New York, NY; Springer-Verlag (1978).

A review is given of the cases of a fixed or heavy source for a highly-$Z\alpha$ electrodynamics with regards to a fixed or heavy source for a high $Z\alpha$ Coulomb potential. The atomic spectra in high-Z electronic and muonic atoms including muonic helium are presented with emphasis on the Lamb shift and vacuum polarization corrections which test strong field quantum electrodynamics. Also presented are the dynamics of positron production. 200 references. (JFP)

PHYSICS RESEARCH (CONT.)

NUCLEAR PHYSICS

53816 (ANL—78-66) **Physics Division annual review, 1 April 1977—31 March 1978.** (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 279p. P 13/MF A01.

This review of research activity for the year ending in April 1978 contains information on the following subjects: the superconducting linac, medium-energy physics, heavy-ion physics, charged-particle research, accelerator operations, neutron physics, theoretical physics, and experimental atomic and molecular physics. Lists of publications and personnel are also given. Twenty-one items with significant data were abstracted and indexed individually. 58 figures, 4 tables. (RWR)

53817 (DOE/NDC—16/U) **Compilation of requests for nuclear data.** (Brookhaven National Lab., Upton, NY (USA)). Apr 1979. Contract EY-76-C-02-0016. 82p. (BNL-NCS—51005). P 05/MF A01.

The purpose of this compilation is to summarize the current needs of US Nuclear Energy programs and other applied technologies for nuclear data. At the present time needs fall primarily in the area of neutron cross sections, although no such limitation is intended. This request list is ordered by target nucleus (isotope) and then reaction type (quantity). An attempt is made to describe the quantity in standard notation. A glossary of these symbols with a short explanatory text is provided. All requests must give the energy (or range of energy) for the incident particle when appropriate. The accuracy needed in percent is also given. The error quoted is assumed to be 1 σ at each measured point in the energy range requested unless a comment specifies otherwise. (RWR)

NUCLEAR PROPERTIES AND REACTIONS, A=1-5, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

53818 (ANL—78-66, pp 80-81) **Radiative capture of alphas on deuterium.** Bowles, T.J.; Robertson, R.G.H.; Warner, R.A.; Dyer, P.; Melin, R. 1978.

In Physics Division annual review, 1 April 1977—31 March 1978.

The radiative capture of α particles on deuterium from 3.3 to 9.8 MeV excitation energy was measured. The increase in cross section above 4.1 MeV is attributed to direct E1 radiative capture from continuum states into the O^+, T = 1 state at 3.56 MeV. 1 table.

53819 (SLAC-PUB—2373) **Large momentum transfer electron scattering from few-nucleon systems.** Arnold, R.G. (American Univ., Washington, DC; Stanford Linear Accelerator Center, CA (USA)). Aug 1979. Contract EY-76-C-03-0515. 18p. P 02/MF A01.

From International school of intermediate energy nuclear physics; Ariccia, Italy (18 Jun 1979).

A review is given of the experimental results from a series of measurements at SLAC of large momentum transfer ($Q^2 > 20$ fm^{-2}) electron scattering at forward angles from nuclei with $A \leq 4$. Theoretical interpretations of these data in terms of traditional nuclear physics models and in terms of quark constituent models are described. Some physics questions for future experiments are explored, and a preview of possible future measurements of magnetic structure functions of light nuclei at large Q^2 is given.

NUCLEAR PROPERTIES AND REACTIONS, A=6-19 THEORETICAL

ENERGY LEVELS AND TRANSITIONS

53820 (ANL—78-66, pp 146-148) **Evidence for an isotensor nucleon—nucleon interaction.** Lawson, R.D. 1978.

In Physics Division annual review, 1 April 1977—31 March 1978.

The coefficient of the square term in the isobaric mass-multiplet equation was computed for 1p-shell nuclei. Vacuum polarization, $(v/c)^2$ corrections, nucleon size effects, and short-range correlations were included. Subsequent calculations including a short-range isotensor interaction showed a markedly better agreement with experiment. 1 table. (RWR)

NUCLEAR PROPERTIES AND REACTIONS, A=6-19, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

53821 (ANL—78-66, pp 37-38) **Maximum fusion cross section for $^{12}C + {}^{15}N$.** Geesaman, D.F.; Henning, W.; Kovar, D.G.; Rehm, K.E.; Schiffer, J.P.; Tabor, S.L. 1978.

In Physics Division annual review, 1 April 1977—31 March 1978.

A ^{12}C target was bombarded with ^{13}C ions. Angular distributions were measured at 19, 36, and 52 MeV, and an excitation function was measured from 16 to 52 MeV. No oscillatory behavior was seen. The maximum fusion cross section was 960 +- 50 mb. 1 figure. (RWR)

53822 (ANL—78-66, pp 38-39) **Structure in the fusion of $^{16}O + {}^{16}O$.** Geesaman, D.F.; Henning, W.; Jordan, W.; Kovar, D.G.; Maher, J.V.; Prosser, F.W. Jr.; Rehm, K.E.; Schiffer, J.P.; Tabor, S.L. 1978.

In Physics Division annual review, 1 April 1977—31 March 1978.

The cross section was measured from 15 to 35 MeV (c.m.). Oscillatory structure with a period similar to that seen in other systems was noted. The maximum fusion cross section was 975 +- 85 mb. 1 figure. (RWR)

53823 (ANL—78-66, pp 74-75) **Cross sections for light-ion-induced reactions on ^6Li at low energies.** Elwyn, A.J.; Holland, R.E.; Davids, C.N.; Meyer-Schuetzmeister, L.; Mooring, F.P. 1978.

In Physics Division annual review, 1 April 1977—31 March 1978.

Cross sections for the $^6Li(p,{}^3He)\alpha$ reaction at 0.1 to 1.0 MeV were measured and compared with results of others to 3 MeV. 1 figure. (RWR)

53824 (ANL—78-66, pp 116-118) **Effects of radiative channel and potential capture in the $^{17}O(\gamma,n_0)^{16}O$ reaction.** Holt, R.J.; Jackson, H.E.; Laszewski, R.M.; Monahan, J.E.; Specht, J.R. 1978.

In Physics Division annual review, 1 April 1977—31 March 1978.

The differential cross section for the $^{17}O(\gamma,n_0)^{16}O$ reaction was observed with high resolution throughout the photon energy range 4.5 to 7.0 MeV and at angles of 90^0 and 135^0. The observed cross sections are shown. The interesting features of the spectra are a novel interference pattern in the form of a symmetric minimum at 5.38 MeV, the first directly observed nonresonant cross section in a photoneutron reaction, and the best example of a single-particle M1 spin-flip transition at 5.08 MeV. The results were interpreted in terms of the theory of radiative capture of Lane and Lynn. 1 figure.

53825 (LBL—9009) **Reaction mechanisms and production of exotic nuclei using 200 MeV/n ^{40}Ar.** Westfall, G.D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1979. Contract W-7405-ENG-48. 5p. (CONF-790140—5). P 02/MF A01.

From International workshop on gross properties of nuclei and nuclear excitations VII; Hirschegg, Kleinwalsertal, Austria (15 Jan 1979).

In order to study the reaction mechanism, carbon and thorium targets were bombarded by 213 MeV/n ^{40}Ar ions. Energy spectra were measured at 0 to 4°. The ^{34}S energy spectrum distribution widths can be related to the nuclear temperature giving a value of 9.6 + 1.1 MeV. The measured isotope production cross sections for the carbon target are also given. The yields of very neutron-rich nuclei resulting from the fragmentation of ^{40}Ar at 205 MeV/n were also measured, and the projected spectra are discussed. 2 references. (JFP)

53826 (LBL—9493) **Fragmentation of relativistic light nuclei: longitudinal and transverse momentum distributions data tables.** Anderson, L.M. Jr.; Chamberlain, O.; Nagamiya, S.; Nissen-Meyer, S.; Nygren, D.; Schroeder, L.; Shapiro, G.; Steiner, H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1979. Contract W-7405-ENG-48. 2p. Dep. NTIS, PC E03/MF E03.

Graphs and tables of momentum distributions from nuclear bombardment by protons, deuterons, etc., are presented on microfiche. (RWR)

53827 **Neutron yields from alpha-particle bombardment.** Bair, J.K.; del Campo, J.G. (Oak Ridge National Lab., TN). *Nucl. Sci. Eng.;* **71**: No. 1, 18-28(Jul 1979).

Thick-target (α,n) neutron yields have been measured for / sup 6,7,NAT/Li, ^{9}Be, /sup 10,11,NAT/B, Pb^{19}F$_2$, Zn ^{19}F$_2$, /sup NAT/Mg, ^{27}Al, /sup NAT/Si, and ^{28}Si/sup NAT/O$_2$. From the Pb^{19}F$_2$ and Zn^{19}F$_2$ data, we have extracted the neutron yield that would result from the (α,n) reaction on a thick target of pure fluorine. Using the ^{28}Si/sup NAT/O$_2$ data, the yield that would result from the (α,n) reaction on a thick target of pure /sup NAT/O$_2$ and the /sup NAT/O(α,n) cross section at alpha-particle energies above those for which measurements previously existed have been extracted. In addition, the thin-target oxygen cross section to obtain a correction to the previously measured values. Thick-target yields are calculated from the cross-section values for carbon and oxygen and are compared to the experimental thick-target data. Thick-target yields for ^{238}U/sup NAT/O$_2$ and for ^{238}U/sup NAT/C are calculated from the thin-target cross sections. Results are compared to existing experiment and calculations.

53828 **Tritium production in a sphere of ^{6}LiD irradiated by 14-MeV neutrons.** Hemmendinger, A.; Ragan, C.E.; Wallace, J.M. (Univ. of California, Los Alamos, NM). *Nucl. Sci. Eng.;* **70**: No. 3, 274-280(Jun 1979).

The specific production of tritium in a 600-mm-diam sphere of ^{6}LiD irradiated by a central source of 14-MeV neutrons was determined by measuring the tritium radioactivity in samples of ^{6}LiH and ^{7}LiH embedded in the sphere. Results are reported for several samples of each isotope at each of five different radii in the assembly. The entire process of decomposing the LiH samples, transferring the evolved gas into counters, and determining the decay rate was standardized by processing LiH samples irradiated by thermal neutrons, for which the ^{6}Li(n,α) cross section is well known. These experiments provide benchmark measurements for checking calculations of neutron transport and tritium production in ^{6}LiD. Tritium production in each ampule, as calculated using a three-dimensional Monte Carlo code, is in reasonable agreement with the experiment. For ^{7}Li, discrepancies between calculation and experiment seem to be due to errors in the tritium production cross sections. 19 references.

53829 **Neutron interaction with carbon-12 in the few-MeV region.** Smith, A.; Holt, R.; Whalen, J. (Argonne National Lab., IL). *Nucl. Sci. Eng.;* **70**: No. 3, 281-293(Jun 1979).

Neutron total cross sections of natural carbon are deduced from the observed transmission of approximately monoenergetic neutrons through carbon samples of various thicknesses. The measurements extend from ~ 0.1 to 4.5 MeV, with resolutions of ~ 2 to 100 keV. Neutron differential elastic scattering cross sections of natural carbon are measured from 1.5 to 4.0 MeV at incident neutron energy intervals of ~ < 100 keV, over an angular range of ~ 20 to 160 deg and with energy resolutions of 20 to 50 keV. The experimental results are interpreted in terms of a multilevel R-function analysis. Results are compared with measured and evaluated neutron total and scattering cross sections and with scattered neutron polarization data reported in the literature. The present work suggests that the observed neutron total and scattering cross sections of carbon are physically consistent and suitable for use as a reference standard in experimental studies of neutron processes. The R-function interpretation provides a convenient description of neutron total and scattering cross sections of carbon as a function of both angle and energy.

NUCLEAR PROPERTIES AND REACTIONS, A=20-38, EXPERIMENTAL

REFER ALSO TO CITATION(S) 53833

ENERGY LEVELS AND TRANSITIONS

53830 (ANL—78-66, pp 118-119) **Doorway states in ^{29}Si(γ,n).** Jackson, H.E.; Holt, R.J.; Laszewski, R.M. 1978.

In Physics Division annual review, 1 April 1977—31 March 1978.

Results of a correlation analysis of the ground-state radiation widths and reduced neutron widths for resonances in ^{29}Si are shown. 1 figure. (RWR)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 53827

53831 (ANL—78-66, pp 40-41) **Measurement of fusion cross sections for ^{16} ^{18}O + ^{24} ^{26}Mg reactions.** Tabor, S.L.; Geesaman, D.F.; Henning, W.; Kovar, D.G.; Rehm, K.E.; Prosser, F.W. Jr. 1978.

In Physics Division annual review, 1 April 1977—31 March 1978.

Measurements of the energy dependence of the total fusion cross section σ/sub fus/(E) for the ^{16}O + ^{24}Mg, ^{18}O + ^{24}Mg, and ^{16}O + ^{26}Mg systems over the energy range 30 MeV ≦ E/sub lab/ ≦ 81 MeV were completed. The measurements show that the three systems studied have σ/sub fus/(E) behaviors which are very similar except at the highest energies (i.e., E/sub lab/ ≃ 70 MeV), where the σ/sub fus/(E) for the ^{16}O + ^{26}Mg and ^{18}O + ^{24}Mg systems saturate at values approximately 100 mb higher than for the ^{16}O + ^{24}Mg system. Analyses of the results in the framework of reaction models show that the observed σ/sub fus/(E) imply anomalously large (~ 10%) differences in the interaction-barrier radii. 1 figure.

53832 (ANL—78-66, pp 41-42) **Energy dependence of total fusion cross section for (^{12}C + ^{24}Mg).** Daneshvar, K.; Kovar, D.G. 1978.

In Physics Division annual review, 1 April 1977—31 March 1978.

The total fusion cross section and elastic scattering were measured in the energy range of E/sub lab/ = 20 to 60 MeV for ^{12}C + ^{24}Mg. The results of a classical calculation (Bass model) for the fusion cross section are shown. The predicted σ/sub fus/(E) are in rather good agreement with the data. 1 figure.

53833 (LBL—9405) **Dominance of strong absorption in ^{9}Be + ^{28}Si elastic scattering.** Zisman, M.S.; Cramer, J.G.; DeVries, R.M.; Goldberg, D.A.; Watson, J.W. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1979. Contract W-7405-ENG-48. 12p. (CONF-790743—1). P 02/MF A01.

From Symposium on heavy ion physics from 10-200 MeV/A; Upton, NY, USA (16 Jul 1979).

Because the character of the scattering changes markedly from ^{6}Li to ^{12}C projectiles, a study of the ^{9}Be + ^{28}Si system was undertaken to examine the transition region. Data were measured at 121.0 and 201.6 MeV. Low-energy data of other investigators were used to carry out global optical model searches. It was found that the elastic scattering of ^{9}Be from ^{28}Si is dominated at all energies by relatively strong absorption. This removes much of the sensitivity to the real potential, and even elastic scattering data spanning a range of energies from 13 to 201 MeV do not allow a unique determination of the potential parameters. There is at least circumstantial evidence that ^{6}Li scattering at low energies (and by implication also ^{9}Be scattering) may be strongly influenced by breakup processes, although it is not clear that the mechanism is the same. 3 figures, 1 table. (RWR)

NUCLEAR PROPERTIES AND REACTIONS, A=39-58, EXPERIMENTAL

MASS, ABUNDANCE, AND BINDING ENERGY

53834 (ANL—78-66, pp 88-89) **Mass and β decay of ^{57}Cr.** Davids, C.N.; Geesaman, D.F.; Murphy, M.J.; Norman, E.B.; Pardo, R.C.; Tabor, S.L. 1978.

In Physics Division annual review, 1 April 1977—31 March 1978.

The mass and β-decay scheme was obtained for ^{57}Cr (T/sub 1/2/ = 21.1 +- 1.0 s). The ground-state-to-ground-state β-branching ratio was extracted. The measured ^{57}Cr mass excess, -52.39 +- 0.10 MeV, is slightly more bound than was predicted by the modi-

fied shell-model mass equation. The assignment of $3/2^-$ for the spin and parity of the ^{57}Cr ground state was made. 1 figure.

RADIOACTIVE DECAY

REFER ALSO TO CITATION(S) 53834

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 53834

53835 (ANL—78-66, pp 85-86) **Positive-parity states in ^{43}Ti.** Meyer-Schuetzmeister, L.; Holland, R.E.; Hardie, G.; Elwyn, A.J.; Gronemeyer, S.A.; Rehm, K.E. 1978.

In Physics Division annual review, 1 April 1977—31 March 1978.

Positive-parity states of ^{43}Ti were studied in the ^{40}Ca(α,n)^{43}Ti reaction with alpha particles of 20-MeV energy. The mean life of the $3/2^+$ state at 313.0 keV was measured to be 18.2 +- 0.8 μs. It was suggested that only the positive-parity states decay to the ground state predominantly via the isomeric $3/2^+$ state, so the gamma rays emitted from positive-parity states were selected and studied by measuring a gamma-ray spectrum in coincidence with the delayed 313.0 gammas. A level scheme is presented. The energies of the positive-parity states behave like those in a rotational band built on the $3/2^+$ level. 1 figure.

53836 (ORO—10335-1) **Research in nuclear physics. Progress report, December 1, 1978—July 31, 1979.** Kozub, R.L. (Tennessee Technological Univ., Cookeville (USA). Dept. of Physics). 1979. Contract AS05-79ER10335. 26p. P 03/MF A01.

Research performed during this eight-month period is described. All experimental work was done at BNL. The research involved γ excitation functions for HI reactions with Li, the lifetime of the 6590-keV state of ^{12}C, and the feasibility of observing high-spin states in fp-shell nuclei by use of inverse reactions. The paper on γ excitation functions is abstracted and indexed separately. (RWR)

MOMENTS AND SPIN

REFER ALSO TO CITATION(S) 53834

NUCLEAR REACTIONS AND SCATTERING

53837 (ANL—78-66, pp 46-48) **Inelastic scattering of ^{16}O on even-Ca isotopes.** Rehm, K.E.; Henning, W.; Erskine, J.R.; Kovar, D.G. 1978.

In Physics Division annual review, 1 April 1977—31 March 1978.

Scattering by ^{40}Ca to states at 0.00, 3.90, 3.73, and 4.49 MeV was analyzed by DWBA and coupled-channels (CC) calculations for 60-MeV ^{16}O. CC calculations of angular distributions from scattering to the first excited states of ^{42}Ca and ^{44}Ca are also shown. 2 figures. (RWR)

53838 (CONF-790610—5) **Photon scattering by the giant dipole resonance.** Bowles, T.J.; Holt, R.J.; Jackson, H.E.; McKeown, R.D.; Specht, J.R. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 25p. P 02/MF A01.

From International conference on nuclear physics with electromagnetic interactions; Mainz, F.R. Germany (5 Jun 1979).

Although many features of the giant dipole resonance are well known, the coupling between the basic dipole oscillation and other nuclear collective degrees of freedom such as surface vibrations and rotations is poorly understood. This aspect was investigated by elastic and inelastic bremsstrahlung scattering of tagged photons over the energy range 15 to 22 MeV. Target nuclei were ^{60}Ni, ^{52}Cr, ^{56}Fe, ^{92}Mo, and ^{96}Mo. Scattering and absorption cross sections are tabulated, along with parameters obtained from a two-Lorentzian analysis of the scattering cross sections; measured spectra are shown. It was necessary to remove Thomson scattering from the experimental results. It was found that coupling to surface vibrations in the giant dipole resonance is much weaker than the dynamic collective model suggests. The elastic scattering cross section for all targets but ^{60}Ni showed structure that is not evident in the absorption cross section measurement. 12 figures, 2 tables. (RWR)

53839 (LA—7863) **Polarized triton elastic scattering data.** Hardekopf, R.A.; Haglund, R.F. Jr.; Ohlsen, G.G.; Veeser, L.R. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 15p. P 02/MF A01.

Different-cross-section and analyzing-power angular distrbutions were measured for 17-MeV polarized triton elastic scattering. The 13 target nuclei spanned the range $40 \leqq A \leqq 208$, and the angular range was $20^0 \leqq \Theta \leqq 160^0$. The data are presented in tables and graphs. 8 references.

53840 (ORNL—5563) **Cross sections for the Ti(n,xn) and Ti(n,xγ) reactions between 1 and 20 MeV.** Morgan, G.L. (Oak Ridge National Lab., TN (USA)). Aug 1979. Contract W-7405-ENG-26. 34p. P 03/MF A01.

Differential cross sections for the production of secondary neutrons and gamma rays from neutron interactions in natural titanium were measured at 130 deg. (lab) for incident neutron energies in the range 1 to 20 MeV. An electron linac was used as a pulsed, white neutron source. Incident neutron energies were determined using time-of-flight techniques for a source-to-sample distance of 48 m. Secondary spectra were determined by unfolding the pulse-height distributions observed in a NE-213 scintillation counter. The results are compared to the current evaluated nuclear data file (ENDF/B-IV, MAT 1286). 23 references.

NUCLEAR PROPERTIES AND REACTIONS, A=59-89, EXPERIMENTAL

MASS, ABUNDANCE, AND BINDING ENERGY

53841 (ANL—78-66, pp 92) **Mass and level structure of ^{67}Ge.** Murphy, M.J.; Davids, C.N.; Norman, E.B.; Pardo, R.C. 1978.

In Physics Division annual review, 1 April 1977—31 March 1978.

The mass excess of ^{67}Ge was measured to be -62666 +- 12 keV, and its low-lying odd-parity excited states were identified. Included among these new levels is an isomer at 18.2 keV with a total mean lifetime of 18.5 +- 0.3 μs. The lifetime of this isomer was compared with that of known isomers of five neighboring N = 35 and N = 37 nuclei. There is a systematic trend observed toward longer lifetime with the addition of neutron pairs. Theoretical calculations using explicit shell and quasiparticle models show this trend to be consistent with the known short-range pairing force in these nuclei. 1 figure.

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 53841

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 53803, 53826, 53838, 53839

53842 (ANL—78-66, pp 24-26) **Gamma-ray study of pion-induced reactions on complex nuclei.** Jackson, H.E. (Argonne National Lab., IL); Kaufman, S.B.; Meyer-Schuetzmeister, L. 1978.

In Physics Division annual review, 1 April 1977—31 March 1978.

Cross sections for the production of final nuclides in the reaction of 220-MeV π^- with ^{62}Ni are shown in histogram form (cross section vs both Z and N). Results of both prompt and delayed γ measurements are included. 1 figure. (RWR)

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, EXPERIMENTAL

REFER ALSO TO CITATION(S) 53849

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 53847

53843 (ANL—78-66, pp 57-58) **Pd(^{16}O,xn)Xe.** Smither, R.K.; Friedman, A.M.; Ahmad, I.; Bushnell, D.L. 1978.

In Physics Division annual review, 1 April 1977—31 March 1978.

The main objective of this work was to observe in Xe the large nuclear-structure change that occurs in Cd and Te at the neutron number N = 60 to 66. This nuclear-structure change (a sudden decrease in the level spacings in the ground-state rotational band with increasing neutron number) was seen in these experiments in the level schemes of ^{116}Xe(N =62), ^{118}Xe(N = 64), and ^{120}Xe(N = 66). The nuclear structure change appears to be associated with the closure of a neutron subshell at N = 62 to 64. 1 figure.

53844 (ANL—78-66, pp 58-59) **Heavy-ion Coulomb excitation in $^{148,\ 150,\ 152,\ 154}$Sm.** Smither, R.K.; Bushnell, D.L.; Friedman, A.M.; Ahmad, I. 1978.

In Physics Division annual review, 1 April 1977—31 March 1978.

The object of the work was to improve the accuracy of relative B(E2) values for low-lying transitions. A partial level scheme of ^{148}Sm with relative branching ratios is shown. 1 figure. (RWR)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 53810, 53838, 53839, 53848, 53857

53845 (COO—2479-16) **Neutron cross section measurements for the Fast Breeder Program.** Block, R.C. (Rensselaer Polytechnic Inst., Troy, NY (USA)). Jun 1979. Contract EY-76-S-02-2479. 8p. P 02/MF A01.

This research was concerned with the measurement of neutron cross sections of importance to the Fast Breeder Reactor. The capture and total cross sections of fission products (^{101} ^{102} ^{104}Ru, ^{143} ^{145}Nd, ^{149}Sm, ^{95} ^{97}Mo, Cs, Pr, Pd, ^{107}Pd, ^{99}Tc) and tag gases (Kr, ^{78} ^{80}Kr) were measured up to 100 keV. Filtered neutron beams were used to measure the capture cross section of ^{238}U (with an Fe filter) and the total cross section of Na (with a Na filter). A radioactive neutron capture detector was developed. A list of publications is included.

53846 (ORO—5128-19) **Cyclotron Laboratory Experimental Nuclear Science Program, June 1, 1976—June 30, 1977.** (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). May 1978. Contract EY-76-S-05-5128. 41p. P 03/MF A01.

Experimental research on nuclear reactions is summarized. A list of publications is included. (JFP)

SPONTANEOUS AND INDUCED FISSION

REFER ALSO TO CITATION(S) 53845

NUCLEAR PROPERTIES AND REACTIONS, A=150-189, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

53847 (ANL—78-66, pp 54-57) **Study of high spin isomeric states near the closed neutron shell.** Khoo, T.L.; Smither, R.K.; Andrews, R.; Haas, B.; Hauesser, O.; Horn, D.; Ward, D. 1978.

In Physics Division annual review, 1 April 1977—31 March 1978.

Sn and Te targets were bombarded with ^{32}S beams. γ multiplicity, isomer energy, and isomer spin are tabulated. A plot E vs I(I+1) for the yrast states of ^{152}Dy is also shown. On average, E = E_0 + (h-bar 2/2 script-I)I(I+1). The spin of the highest-lying state is 37 h-bar. 1 figure, 1 table. (RWR)

NUCLEAR REACTIONS AND SCATTERING

53848 (COO—2696-007) **Determination of neutron cross sections and resonance parameters for the stable tellurium isotopes for thallium 205 and for the osmium isotopes. Progress report, October 1, 1978-March 1, 1979.** Winters, R.R. (Denison Univ., Granville, OH (USA)). 9 Mar 1979. Contract EY-76-S-02-2696. 13p. P 02/MF A01.

Initial measurements by LLL and NBS of the ratio of the ^{186}Os capture cross section to that of ^{187}Os near 30 keV, provided a crucial input parameter for use of the Re-Os chronometer to estimate the duration of nucleosynthesis and hence the age of the universe. The resulting estimate of $\approx$ 20 billion years was much longer than the estimate from the only other method, U-Th dating. The Re-Os chronometer requires, however, not ratios of cross sections measured at laboratory temperatures, but rather the ratio appropriate to the stellar environment in which nucleosynthesis by the s-process occurs. Hence capture from low lying excited states is important. The capture cross section from the 9.75 keV first excited ^{187}Os state must be calculated using Hauser—Feshbach calculations. These calculations require estimates of level densities, neutron transmission functions (for ground and excited states) and radiative transmission functions. These calculations can be experimentally checked by measurements of the total and inelastic cross sections near threshold. The inelastic experiment is particularly difficult because of the requirement of low background and relatively high efficiency for detection of $\approx$ 30 keV neutrons. A proton-recoil detector has been developed which appears to provide adequate efficiency and energy resolution. A novel filter composed of alternate layers of iron, aluminum and air has been designed to eliminate neutrons other than those in the 25 keV Fe and Al window. Major problems in background reduction persist and might be helped with a sample of ^{187}Os of isotopic greater than that of the presently available 70% ^{187}Os sample.

NUCLEAR PROPERTIES AND REACTIONS, A=190-219, THEORETICAL

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 53856

53849 (ORNL/TM—7000) **Time-dependent Hartree—Fock calculations of the scattering of Kr-ions from ^{208}Pb, ^{209}Bi, and ^{139}La.** Davies, K.T.R. (Oak Ridge National Lab., TN (USA)). Aug 1979. Contract W-7405-ENG-26. 46p. P 03/MF A01.

Time-dependent mean-field calculations were performed for the reactions ^{84}Kr + ^{209}Pb at E/sub lab/ = 494 MeV and ^{84}Kr + ^{209}Bi at E/sub lab/ = 600 and 714 MeV. The model used is the 2D rigid clutching approximation with nondegenerate neutron and proton states and a nonlocal, finite-range Skyrme-type effective interaction. At E/sub lab/ = 494 and 600 MeV the calculated final fragment kinetic energies, scattering angles, and mean masses are in good agreement with experiment, but the mass and charge distribution widths are an order of magnitude smaller than the experimental values. At E/sub lab/ = 714 MeV there are other discrepancies; e.g. the large-angle (small-angular-momentum) events are above the experimental ridge on the Wilczynski plot. In addition, time-dependent Hartree—Fock calculations were recently completed for the reactions ^{86}Kr + ^{139}La at E/sub lab/ = 505, 610, and 710 MeV. At all three energies the final kinetic energy loss and angular dependence are in only fair agreement with experiment, the most serious discrepancies occurring for the large-angle fully damped events whose calculated outgoing kinetic energies are about 50 MeV above the experimental ridge on the Wilczynski plots. Fusion is not seen at the two lower energies, but for E/sub lab/ = 710 MeV fusion is obtained for angular momenta from 0 to 65 h-bar. Just beyond the upper fusion limit of 65 h-bar, positive-angle scattering is observed, in contrast to the negative-angle scattering always seen before the onset of fusion for reactions of lighter ions. It is suggested that the fusion behavior for this reaction may be a definitive test of whether heavy-ion scattering is better described by a microscopic mean-field theory or macroscopicfluid dynamics. At 710 MeV, emission of alpha-like particles from the neck at scission is observed for a small range of angular momenta near 100 h-bar. Various limitations of the approximations used are discussed. 17 figures.

NUCLEAR PROPERTIES AND REACTIONS, A=190-219, EXPERIMENTAL

MOMENTS AND SPIN

53850 (DOE/TIC—10198) **Giant multipole resonances: an experimental review.** Bertrand, F.E. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 70p. P 05/MF A01.

During the past several years experimental evidence has been published for the existance of nondipole giant resonances. These giant multipole resonances, the so-called new giant resonances were first observed through inelastic hadron and electron scattering and such measurements have continued to provide most of the information in this field. A summary is provided of the experimental evidence for these new resonances. The discussion deals only with results from inelastic scattering and only with the electric multipoles. Emphasis is placed on the recent observations of the giant monopole resonance. Results from recent heavy-ion and pion inelastic scattering are discussed. 38 references.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 53826, 53839, 53850

SPONTANEOUS AND INDUCED FISSION

REFER ALSO TO CITATION(S) 53855

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, EXPERIMENTAL

RADIOACTIVE DECAY

53851 **Emission probability of the 312-keV gamma ray from the decay of protactinium-233.** Gehrke, R.J.; Helmer, R.G.; Reich, C.W. (EG & G Idaho, Inc., Idaho Falls). *Nucl. Sci. Eng.*; 70: No. 3, 298-306(Jun 1979).

The emission probability of the 312-keV gamma ray from the decay of 27-day ^{233}Pa was measured. A 4π beta-gamma coincidence counting system was used to determine the ^{233}Pa sample disintegration rates, and Ge(Li) spectrometers were used to measure the gamma-ray emission rates. The resulting value for the emission probability is I/sub γ/(312 keV) = (38.6 +- 0.5) photon/100 decays. The relative intensities of the K x rays and gamma rays emitted in the decay of ^{233}Pa were also measured. 30 references.

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 53851

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 53825, 53827, 53845

SPONTANEOUS AND INDUCED FISSION

REFER ALSO TO CITATION(S) 53845

53852 **Technical notes: self-shielded fission rates for uranium-235.** Czirr, J.B. (Univ. of California, Livermore). *Nucl. Sci. Eng.;* 70: No. 3, 307-308(Jun 1979).

The relative self-shielded fission rate was measured for ^{235}U in the energy range from 0.464 to 2150 eV. Absorber thicknesses from 0.5 to 19 g/cm^2 of ^{235}U-enriched uranium were used. The measurement was performed to improve on data obtained previously under high-background conditions.

NUCLEAR THEORY

NUCLEAR STRUCTURE

REFER ALSO TO CITATION(S) 53820

NUCLEAR MATTER

REFER ALSO TO CITATION(S) 53808

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 53812

53853 (LBL—9130) **Lecture 1: Experimental evidence for collective and therma! features in heavy ion reactions. Lecture 2: Equilibrium statistical treatment of angular momenta associated with collective modes in fission and heavy-ion reactions.** Moretto, L.G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1979. Contract W-7405-ENG-48. 132p. (CONF-790751—1; CONF-790751—2). P 07/MF A01.

From International summer school on heavy ion nuclear reactions; Varenna, Italy (9 Jul 1979).

Separate abstracts were prepared for the two lectures presented. (JFP)

53854 (LBL—9130, pp 1-84) **Lecture 1: Experimental evidence for collective and thermal features in heavy ion reactions.** Moretto, L.G. (Univ. of California, Berkeley). May 1979.

From International summer school on heavy ion nuclear reactions; Varenna, Italy (9 Jul 1979).

The set of degrees of freedom playing a relevant role in deep inelastic processes is discussed. General considerations concerning the dynamic regimes prevailing during the nucleus—nucleus interaction lead to interesting conclusions regarding classical and quantal features as well as to the applicability of transport theories. The damping associated with the relative distance coordinate is considered and the evidence for thermal equilibrium between fragments is presented. The role of the E1 mode and of all the other odd isovector modes on the charge distrbution at fixed mass asymmetry is discussed and the posssible evidence for quantal fluctuations is analyzed. The mass asymmetry degree of freedom is considered in terms of the experimental mass distributions. The origin of the two components, deep inelastic and fusion—fission, is explained in terms of different dynamical regimes leading to greatly different interaction times. The rotational degrees of freedom are discussed in terms of γ-ray multiplicities and sequential fission. The problem of angular momentum fractionation along the mass asymmetry coordinate is considered and the depolarization and misalignment of the fragment spins are discussed. 43 references.

53855 (LBL—9130, pp 85-130) **Lecture 2: Equilibrium statistical treatment of angular momenta associated with collective modes in fission and heavy-ion reactions.** Moretto, L.G. (Univ. of California, Berkeley). May 1979.

From International summer school on heavy ion nuclear reactions; Varenna, Italy (9 Jul 1979).

The angular momentum effects in deep inelastic processes and fission have been studied in the limit of statistical equilibrium. The model consists of two touching liquid drop spheres. Angular momentum fractionation has been found to occur along the mass asymmetry coordinate. If neutron competition is included (i.e., in compound nucleus formation and fission), the fractionation occurs only to a slight degree, while extensive fractionation is predicted if no neutron competition occurs (i.e., in fusion—fission without compound nucleus formation). Thermal fluctuations in the angular momentum are predicted to occur due to degrees of freedom which can bear angular momentum, like wriggling, tilting, bending, and twisting. The coupling of relative motion to one of the wriggling modes, leading to fluctuations between orbital and intrinsic angular momentum, is considered first. Next the effect of the excitation of all the collective modes on the fragment spin is treated. General expressions for the first and second moments of the fragment spins are derived as a function of total angular momentum and the limiting behavior at large and small total angular momentum is examined. Furthermore, the effect of collective mode excitation on the fragment spin alignment is explored and is discussed in light of recent experiments. The relevance of the present study to the measured first and second moments of the γ-ray multiplicities as well as to sequential fission angular distributions is illustrated by applying the results of the theory to a well studied heavy ion reaction.

53856 (LBL—9173) **Angular momentum and the collective modes excited in deep-inelastic processes and in fission.** Moretto, L.G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1979. Contract W-7405-ENG-48. 20p. (CONF-790660—5). P 02/MF A01.

From Conference on large amplitude collective nuclear motion; Lake Balaton, Hungary (10 Jun 1979).

The angular momentum effects in deep inelastic processes and fission were studied in the limit of statistical equilibrium. The model consists of two touching liquid drop spheres. Angular momentum fractionation was found to occur along the mass asymmetry coordinate. Thermal excitation of fragment spin is predicted to occur in the degrees of freedom which can bear angular momentum, like wriggling, tilting, bending, and twisting. 17 references.

53857 (LBL—9494) **Heavy ion collisions at relativistic energies.** Nagamiya, S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1979. Contract W-7405-ENG-48. 70p. (CONF-790743—3). P 04/MF A01.

From Symposium on heavy ion physics from 10-200 MeV/A; Upton, NY, USA (16 Jul 1979).

The current understanding of the reaction mechanism is reviewed and described with the major interests related to geometry and dynamics. Also recent measurements of some new phenomena which cannot be easily explained within the framework of the available theoretical tools, phenomena that were observed at beam energies of 0.4 to 2 GeV/A are described. Topics for future study are briefly mentioned especially in connection with the study of collisions at beam energies of 10 to 200 MeV/A. 48 references. (JFP)

SPONTANEOUS AND INDUCED FISSION

REFER ALSO TO CITATION(S) 53855, 53856

RADIATION AND SHIELDING PHYSICS

RADIATION PHYSICS

REFER ALSO TO CITATION(S) 53784

53858 (CONF-790524—11) **Recent developments in electron degradation theory: selected topics.** Douthat, D.A. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 12p. P 02/MF A01.

From 6. international congress symposium on radiation research and stem cells; Tokyo, Japan (13 May 1979).

The electron degradation spectrum, essentially an energy distribution function of an irradiated system, provides a general basis for determining, not only the fate of the incident (or internally produced) radiation, but also for determining the initial or primary yields of the various excited states of the medium. The degradation spectrum thus describes the initial response of the medium to the radiation. This review-type paper focuses on results obtained in calculations for molecular hydrogen gas. The treatment is presented under the following headings: bookkeeping methods; definition of the degradation spectrum; collision data; water vapor; the total ionization cross section; modification of Gerhart's data; sensitivity of the computed degradation spectrum and mean energy per ion pair; initial yields in H_2; spectra of sub-excitation electrons; and spatial distributions. 70 references, 3 figures, 2 tables. (RWR)

53859 (LA-UR—79-1954) **Method of optimal truncation: a new t-matrix approach to elastic wave scattering.** Visscher, W.M. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 16p. (CONF-7906109—1). P 02/MF A01.

From Conference on focus on the T-Matrix approach; Columbus, OH, USA (25 Jun 1979).

A family of matrix theories of elastic wave scattering is derived, and one, which is in a certain sense optimal, is developed. Called the method of optimal truncation (MOOT), it results from a minimum principle and can be shown to yield a convergent sequence of approximations. Numerical results for scattering cross-sections for longitudinal incident waves with ka $\leqq$ 10 from fixed rigid obstacles and voids with axial symmetry are obtained using MOOT, and are

compared with results of other matrix theories. Shapes considered include spheres, oblate and prolate spheroids, pillboxes, and cones. Convergence is demonstrated. Extension of the method to elastic and fluid inclusions is discussed, as is its application to cracks, which may be accomplished by simulating the crack with an incompletely bonded identical inclusion. Implications of reciprocity and time-reversal invariance are discussed.

53860 (SAND—79-0845) **Electron energy and mean forward range in air resulting from the ETA factor treatment of scattering in the continuous slowing down approximation.** Vittitoe, C.N. (Sandia Labs., Albuquerque, NM (USA)). Aug 1979. Contract EY-76-C-04-0789. 22p. P 02/MF A01.

This paper provides a method for making quick estimates of the electron-beam mean penetration depth and of the variation of mean electron energy and associated speed with propagation distance in the beam's forward direction. The continuous slowing down approximation is used with the eta-function modification developed by Longmire to account for scattering. The method is applied to electrons with initial kinetic energy ranging from 5 keV to 3 MeV slowing down in air at STP. Comparisons with Monte Carlo calculations indicate that the method is useful in determining the mean electron range in the forward direction. The method also provides rough estimates of the variation in mean electron energy and associated speed with propagation distance. However, these variations are better predicted by readily available electron transport codes. Results for 1-MeV electrons demonstrate that the electron energy is spread over a characteristic depth approximately equal to the extreme range of the electrons rather than to the mean forward range.

53861 (SLAC-PUB—2346) **Neutrons from medical electron accelerators.** Swanson, W.P.; McCall, R.C. (Stanford Linear Accelerator Center, CA (USA)). Jun 1979. Contract EY-76-C-03-0515. 12p. (CONF-7906110—1). P 02/MF A01.

From 3. all-union conference on applied accelerators; Leningrad, USSR (25 Jun 1979).

The significant sources of photoneutrons within a linear-accelerator treatment head are identified and absolute estimates of neutron production per treatment dose are given for typical components. Measured data obtained at a variety of accelerator installations are presented and compared with these calculations. It is found that the high-Z materials within the treatment head do not significantly alter the neutron fluence, but do substantially reduce the average energy of the transmitted spectrum. Reflected neutrons from the concrete treatment room contribute to the neutron fluence, but not substantially to the patient integral dose, because of a further reduction in average energy. Absolute depth-dose distributions for realistic neutron spectra are calculated, and a rapid falloff with depth is found.

53862 **On the validity of the extended transport cross-section correction for low-energy electron transport.** Morel, J.E. (Sandia Labs., Albuquerque, NM). *Nucl. Sci. Eng.;* **71**: No. 1, 64-71(Jul 1979).

A brief history of the extended transport correction for Legendre differential scattering cross-section expansions is presented in conjunction with calculations intended to investigate the validity of such expansions for the extremely forward-peaked scattering characteristic of that experienced by electrons. It is concluded from the results that approximate P_{11} cross sections obtained with the extended transport correction can yield excellent scalar flux solutions for electrons with energies between 10 keV and 1 MeV, even through P_{11} expansions are totally inadequate for representing the exact cross sections.

53863 (LA-tr—79-13) **Study of the slowing down of heavy ions in a diatomic target. I. Calculation of the range and the number of primary atoms created.** Soullard, J.; Leteurtre, J.; Genthon, J.P.; Cance, M. Translated from *Radiat. Eff.;* **38**: 119-123(1978). 12p. P 02/MF A01.

A computational code based on the Lindhard, Scharff, and Schiott's theory is described. It determines the range, the energy transferred to the lattice and the number of primary knock-on atoms created during the slowing down of a heavy ion in a diatomic target. The calculated mean range values for uranium ions, oxygen ions, and fission fragments in UO_2 are in good agreement with those obtained from Bragg's formula. The number of primary atoms created by these incident particles was also calculated. It is the first attempt to evaluate the energy transferred to the lattice by high energy heavy ions in a diatomic target.

NEUTRON INTERACTIONS WITH MATTER

REFER ALSO TO CITATION(S) 53464, 53827

53864 (SAND—79-1148C) **Transient annealing in I^2L devices following pulsed neutron irradiation.** Rieden, R.F. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 8p. (CONF-790706—5). P 02/MF A01.

From 1979 IEEE Annual conference on nuclear and space radiation effects; Santa Cruz, CA, USA (17 Jul 1979).

The possibility exists that I^2L circuits may be employed in systems which are required to operate properly during or immediately following a neutron irradiation pulse. Therefore, it is necessary that the active response of the individual I^2L gate to such neutron irradiation be known. A series of experiments has been performed at room temperature to determine both the passive and active response of I^2L gates to neutrons from the SPR reactor at Sandia Laboratories. The data obtained from these experiments has been used to obtain an Annealing Factor (AF) in the same manner that has been done previously for discrete bipolar transistors. The annealing factor can be used to predict the ratio of damage which is present immediately after a neutron burst to that damage obtained from passive neutron irradiation experiments.

53865 (UCRL—50400(Vol.15)(Pt.E)) **Integrated system for production of neutronics and photonics calculational constants. Volume 15, Part E. Data testing results for the LLL Evaluated Nuclear Data Library (ENDL-78).** Howerton, R.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Aug 1979. Contract W-7405-ENG-48. 37p. P 03/MF A01.

The LLL Evaluated Nuclear Data Library (ENDL-78) was tested for validity by comparing calculated and experimental values of k/sub eff/ for 67 critical assemblies and emission neutron spectra for 22 spheres that were pulsed with 14-MeV neutrons. 22 figures, 5 tables.

DOSIMETRY

REFER ALSO TO CITATION(S) 53861

SOLID STATE PHYSICS

REFER ALSO TO CITATION(S) 53496, 53776, 53859

53866 (COO—1198-1253) **Unified theory of dislocation motion including thermal activation and inertial effects.** Isaac, R.D.; Granato, A.V. (Illinois Univ., Urbana (USA)). 1979. Contract EY-76-C-02-1198. 6p. (CONF-790801—2). P 02/MF A01.

From 5. international conference on the strength of metals and alloys; Aachen, F.R. Germany (Aug 1979).

Transition-state rate theory has generally been used to explain the temperature dependence of the flow stress of a crystal. However, the existence of a change in the flow stress during the superconducting transition indicates the presence of inertial effects in which dislocations overcome obstacles mechanically rather than thermally. It is shown here that the thermally activated and the inertial overcoming of obstacles are not unrelated but can both be derived from principles of stochastic motion. This leads to a theory of dislocation motion that includes both thermal activation and inertial effects. It is also shown that a distribution of activation energies must be considered to account for the experimental data.

53867 (COO—2995-3) **Imaging of surfaces and defects of crystals. Progress report, May 1, 1978—April 30, 1979.** Cowley, J.M. (Arizona State Univ., Tempe (USA). Dept. of Physics). Apr 1979. Contract EY-76-S-02-2995. 31p. P 03/MF A01.

The possibility of obtaining electron diffraction patterns from very small specimen regions combined with high resolution imaging by use of scanning transmission electron microscopy (STEM) allows the detailed study of small nuclei of reaction products or of crystal defects. The capabilities of this method have been extended by the design and construction of a TV system for the viewing and recording of microdiffraction patterns from our STEM instrument so that clear patterns can be obtained from regions as small as 10A in diameter. This system has been applied to the study of initial stages of oxidation of chromium films, revealing the presence of very small oxide nuclei and identifying these crystals as having a previously unsuspected spinel structure. The further stages of growth of oxides on chromium are being investigated. Initial results have also been obtained on the surface structure of oxides such as MgO. The extension of previous work on the diffraction from, and imaging of crystal surfaces by the use of medium-to-low energy electrons (15 to 1 keV) has allowed a much more complete understanding of the contrast-producing mechanisms. Application to the study of pyrolytic graphite surfaces has given a clear picture of the mosaic structure and defect distribution and provided a basis for the more reliable and quantitative general use of these techniques in surface structure analysis.

53868 (LA-UR—79-1878) **Properties of s-p and s-d type A-15 superconductors: a comparison.** Giorgi, A.L. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 16p. (CONF-790653—11). P 02/MF A01.

From Superconductivity in d- and f-band metals; San Diego, CA, USA (21 Jun 1979).

In general there are actually two different types of A-15 compounds (A_3B) whose superconducting properties depend on whether the B atoms are transition elements (s-d type) or nontransition elements (s-p type). The properties in which the s-d type superconductors show marked differences in behavior from the s-p type include: (1) stoichiometry and range of composition, (2) the strong influence of N(O) on the stability and T/sub c/ of the phase, and (3), the effect of composition and atomic ordering on the T/sub c/ of the phase. These differences are discussed and a conclusion presented.

53869 (SAND—79-1055C) **Small-polaron formation and motion in magnetic semiconductors.** Emin, D. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 46p. (CONF-790918—1). P 03/MF A01.

From International meeting on magnetic semiconductors; Montpellier, France (10 Sep 1979).

The fundamental physical processes associated with small-polaron formation are described with various magnetic semi-conductors being cited as examples. Attention is then directed toward the mechanisms of charge transfer and small-polaron hopping motion in magnetic semiconductors.

SUPERCONDUCTIVITY

ACOUSTIC, ELECTRIC, MAGNETIC, OPTICAL, AND THERMAL PHENOMENA

REFER ALSO TO CITATION(S) 53441, 53443

53870 (BNL—26400) **Alteration of the superconducting properties of A15 compounds and elementary composite superconductors by non-hydrostatic elastic strain.** Welch, D.O. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 35p. (CONF-790815—10). P 03/MF A01.

From Cryogenic engineering conference; Madison, WI, USA (21 Aug 1979).

Elastic strains alter (usually, but not always, adversely) the critical temperatures, magnetic fields, and current densities of superconducting A15 compounds; non-hydrostatic strain states are particularly effective in this regard. This paper is a review of the experimental evidence, obtained by a variety of techniques, concerning the strain dependence of the critical properties of a number of A15 compounds and a discussion of theoretical models for describing such effects.

THEORETICAL PHYSICS

53871 (LA—7942-MS) **Sampling the Fermi-Dirac density.** Cashwell, E.D.; Everett, C.J. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 16p. P 02/MF A01.

A method is given for sampling the nonrelativistic Fermi-Dirac electron energy density for all values of the degeneracy parameter eta on the range - infinity $<$ eta $\leqq$ 50. The efficiency of the various rejection techniques employed is never less than 30%, and drops below 50% only for a short range of eta values around eta = 2. The range can certainly be extended beyond eta = 50, the efficiency there being 71%, and decreasing very slowly. 5 references.

GENERAL AND MISCELLANEOUS

53872 (BNL—26543) **Numerical methods for Helmholtz type equations in unbounded regions.** Goldstein, C.I. (Brookhaven National Lab., Upton, NY (USA)). May 1979. Contract EY-76-C-02-0016. 21p. P 02/MF A01.

Certain numerical methods for approximately solving Helmholtz type equations in unbounded regions in two the three dimensional space, subject to appropriate radiation conditions at infinity are described.

CLASSICAL AND QUANTUM MECHANICS

REFER ALSO TO CITATION(S) 53814

53873 (ORO—3992-353) **Rigged Hilbert space and decaying states.** Bohm, A. (Texas Univ., Austin (USA). Center for Particle Theory). Oct 1978. Contract EY-76-S-05-3992. 5p. P 02/MF A01.

Generalized eigenvectors of the self-adjoint energy operator with complex eigenvalue for rigged Hilbert space are used to describe a decaying state with the resonance parameter given. The position of this resonance is not calculated. 17 references. (JFP)

STATISTICAL PHYSICS AND THERMODYNAMICS

REFER ALSO TO CITATION(S) 53496

53874 (LA—7934-MS) **Introduction to two-temperature equations of state.** Albers, R.C. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 17p. P 02/MF A01.

A brief introduction to two-temperature equations of state is presented. Current capabilities of T-4 in this area as well as plans for future development are discussed. In addition, we point out various conceptual and practical difficulties in implementing a two-temperature approximation.

ELECTRICITY AND MAGNETISM

53875 (SAND—78-2446C) **COMAG-III: a 2-D MHD code for helical CMF generators.** McGlaun, J.M.; Thompson, S.L.; Freeman, J.R. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 24p. (CONF-790540—12). P 02/MF A01.

From 2. international conference on megagauss magnetic field generation and related topics; Washington, DC, USA (29 May 1979).

COMAG-III is a two-dimensional MHD code which was constructed to study the characteristics of compressed magnetic field generators which incorporate a helically wound output coil. The code is an improved and generalized version of COMAG-I, which was based on a self-consistent coupling of an Eulerian material response treatment with a magnetic field solver which included nonlinear diffusion. COMAG-I also included Joule heating, Lorentz forces, a circuit equation to couple an external load, a model for explosive burn, a detailed equation of state with a mixed phase capability, and a treatment of fracture and spall. In addition to these capabilities, COMAG-III can treat coils with turn-splitting (a technique used to reduce heating effects), and armatures having an arbitrary shape; it also can now include up to ten different materials and has a more general variable zoning capability. Sample results are described. 4 figures.

MATHEMATICAL PHYSICS

53876 (LA—7836-MS) **Methods for numerical conformal mapping.** Menikoff, R.; Zemach, C. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 65p. P 04/MF A01.

Nonlinear integral equations for the boundary functions that determine conformal transformations in two dimensions are developed and analyzed. One of these equations has a nonsingular logarithmic kernel and is especially well suited for numerical computations of conformal maps including those that deal with regions having highly distorted boundaries. Numerical procedures based on interspersed Gaussian quadrature for approximating the integrals and a Newton—Raphson technique to solve the resulting nonlinear algebraic equations are described. The Newton—Raphson iteration converges reliably with very crude initial approximations. Numerical examples are given for the mapping of a half-infinite region with periodic boundary onto a half-plane, with up to 9-figure accuracy for values of the map function on the boundary and for its first derivatives. The examples include regions bounded by spike curves characteristic of Rayleigh—Taylor instability phenomena. A differential equation is derived that relates changes in the map function to changes of the boundary. This is relevant to potential problems for regions with time-dependent boundaries. Further nonsingular integral formulas are derived for conformal mapping in a variety of geometries and for application to the boundary-value problems of potential theory. 4 figures, 4 tables.

FUSION ENERGY

53877 (DOE/TIC—10192) **Fusion energy glossary.** Whitson, M.O. (ed.). (Department of Energy, Oak Ridge, TN (USA). Technical Information Center). Apr 1979. 19p. P 02/MF A01.

This fusion energy glossary is an attempt to present a concise yet comprehensive collection of terms which may be beneficial to scientists and laymen who are directly or tangentially concerned with this burgeoning energy enterprise. Included are definitions of terms in theoretical plasma physics, controlled thermonuclear fusion, and some related physics concepts. Also included are short descriptions of some of the major thermonuclear experiments currently under way in the world today.

53878 (UCRL—82768) **Fusion: the power source of the future Inertial Confinement Option.** Rupert, V. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Jun 1979. Contract W-7405-ENG-48. 19p. (CONF-790698—1). P 02/MF A01.

From Society of Women Engineers national student conference; San Francisco, CA, USA (27 Jun 1979).

Among the various energy options opened to man, fusion appears particularly attractive since fuel is plentiful, cheap, and universally available, the reaction is self quenching, produces in itself no radioactive wastes and radiation hazards are minimum. However, creating on earth conditions emulating the sun is not as easy task. Two significantly different approaches to obtaining the necessary conditions are being actively pursued and both have shown encouraging progress in the past few years. Magnetic confinement will be discussed in the next paper. Inertial confinement fusion is progressing towards scientific breakeven in the 1980's. High yield targets have been successfully imploded proving the feasibility of thermonuclear burn. High densities have recently been achieved using glass lasers as drivers. Power plants using fusion sources are being studied and could become operational in the early 2000's.

53879 Technology index for plasmaphysics research and fusion reactors. Volume 13, No. 4, 1979. Bibliography, author index, subject index, appendix. Leopoldshafen, Germany; Zentralstelle fuer Atomkernenergie-Dokumentation (1979). 58p.

This bibliography contains 252 references. Subject and author indexes are included. (MOW)

53880 Technology index for plasmaphysics research and fusion reactors. Volume 13, No. 5, 1979. Bibliography, author index, subject index, appendix. Leopoldshafen, Germany; Zentralstelle fuer Atomkernenergie-Dokumentation (1979). 59p.

This bibliography contains 249 references dealing with various aspects of plasma physics and controlled thermonuclear research. (MOW)

PLASMA RESEARCH

PLASMA CONFINEMENT AND HEATING

53881 (IAE—2940) **Similarity law for the energy lifetime in tokamaks.** Mirnov, S.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1978. 8p. (In Russian). U 02/MF A01.

Experimental results on plasma thermal insulation in tokamaks are analyzed. It is shown that simple supposition on plasma cold layer existance near the filament boundary permits to introduce some uniformity into experimental results. In particular, in the limits of tokamak microscopically stable regimes the thermal insulation is well described by extrapolation dependence of tausub(E)=3x10^{-9}I(antinsub(e))$^{1/2}$,where tausub(E) is plasma energy lifetime (ratio of plasma energy to power of losses), I is discharge current, and antinsub(e) is plasma density.

53882 (ORNL/TM—6910) **Simple annulus power balance in EBT-I.** Borowski, S.K.; Uckan, N.A.; Jaeger, E.F.; Kammash, T. (Oak Ridge National Lab., TN (USA)). Sep 1979. Contract W-7405-ENG-26. 34p. P 03/MF A01.

An essential feature of the ELMO Bumpy Torus (EBT) concept is the presence of a relativistic electron annulus in each of the toroidal mirror sectors. These high beta annuli are formed and sustained by microwave heating and are of sufficient density and temperature that diamagnetic currents produce the necessary minimum in the magnetic field required for MHD stability of the toroidal core plasma. Because electron rings play an important role in confinement characteristics and performance of EBT, the trade-off between the quality of the confinement afforded by the rings and the power required to sustain the rings represents an important problem in a fusion reactor. Theoretical estimates of the microwave power required to sustain the annulus are found to be within a factor of 2 of the experimentally determined value. Scaling projections that are shown for both EBT-I and EBT-S enable one to examine the sensitivity of the annulus electron temperature as a function of core plasma density for various microwave power levels. The results are found to be sensitive to the details of the hot electron distribution function as well as geometric and scaling parameters. Improvements to the model are under way in order to increase its capability and accuracy in assessing the overall power balance.

53883 (PPPL—1578) **Heating tokamaks by parametric decay of intense extraordinary mode radiation.** Elder, G.B.; Perkins, F.W. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Aug 1979. Contract EY-76-C-02-3073. 38p. P 03/MF A01.

Intense electron beam technology has developed coherent, very high power (350 megawatts) microwave sources at frequencies which are a modest fraction of the electron cyclotron frequency in tokamaks. Propagation into a plasma occurs via the extraordinary mode which is subject to parametric decay instabilities in the density range $\omega/\text{sub o}/^2 < \omega/\text{sub pe}/^2 < \omega/\text{sub o}/(\omega/\text{sub o}/ + \Omega/\text{sub e}/)$. For an incident wave focused onto a hot spot by a dish antenna of radius rho, the effective threshold power P/sub o/ required to induced effective parametric heating is P/sub o/ $\cong$ 10 MW x/rho Ω/sub e//ω/sub o/ (T/sub e//1 keV)/sup 3/2/ where x denotes the distance to the hot spot.

53884 (UCRL—82881) **Steps toward increasing Q in mirror systems.** Post, R.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Aug 1979. Contract W-7405-ENG-48. 24p. P 02/MF A01.

Experiments such as the 2XIIB experiment at Livermore have established the ability of mirror systems to confine high temperature, high density plasmas at central beta values exceeding unity. Given these results the next tasks for the mirror approach are to explore means for increasing the energy gain factor Q and to scale up the plasma volume, both of these requirements deriving from economic constraints. This report discusses means for increasng Q, including recent improvements in the tandem mirror concept and design studies of the field-reversed mirror in the context of upcoming and proposed scaled-up mirror experiments.

53885 (UWFDM—227) **Fast magnetosonic wave heating of the NUWMAK tokamak reactor.** Scharer, J.E.; Blackfield, D.T.; Beyer, J.B.; Mau, T.K. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). Jun 1978. Contract ET-78-S-02-4636. 141p. P 04/MF A01.

Radiofrequency (rf) coupling and heating to ignition of a conceptual tokamak fusion reactor by means of the fast magnetosonic wave at the second ion cyclotron harmonic are discussed. First, the current status of fast magnetosonic wave propagation and heating, mode conversion, and eigenmode theory is briefly reviewed. Next, a space-averaged, time-dependent startup model is used to describe the role of rf heating for ignition of a tokamak reactor. The computational code simultaneously solves the ion and electron energy balance equations. Conduction, convection, and radiative losses are compared with the ion and electron wave heating mechanisms together with alpha-particle heating resulting from fusion reactions.

53886 Neutral-beam—heating results from the Princeton Large Torus. Eubank, H.; Goldston, R.; Arunasalam, V.; Bitter, M.; Bol, K.; Boyd, D.; Bretz, N.; Bussac, J.; Cohen, S.; Colestock, P.; Davis, S.; Dimock, D.; Dylla, H.; Efthimion, P.; Grisham, L.; Hawryluk, R.; Hill, K.; Hinnov, E.; Hosea, J.; Hsuan, H.; Johnson, D.; Martin, G.; Medley, S.; Meservey, E.; Sauthoff, N.; Schilling, G.; Shivell, J.; Schmidt, G.; Stauffer, F.; Stewart, L.; Stodiek, W.; Stooksberry, R.; Strachan, J.; Suckewer, S.; Takahashi, H.; Tait, G.; Ulrickson, M.; von Goeler, S.; Yamada, M.; Tsai, C.; Stirling, W.; Dagenhart, W.; Gardner, W.; Menon, M.; Haselton, H. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Phys. Rev. Lett.;* **43**: No. 4, 270-274(23 Jul 1979).

Experimental results from high-power neutral-beam—injection experiments on the Princeton Large Torus tokamak are reported. At the highest beam powers (2.4 MW) and lowest plasma densities [n/sub e/(0) = 5 x 10^{13}cm^{-3}], ion temperatures of 6.5 keV are achieved. The ion collisionality ν/sub i/* drops below 0.1 over much of the radial profile. Electron heating of ΔT/sub e//T/sub e/ $\cong$ 50% has also been observed, consistent with the gross energy-confinement time of the Ohmically heated plasma, but indicative of enhanced electron-energy confinement in the core of the plasma.

53887 (UCRL-Trans—11485) **One method of decreasing transverse plasma losses from an ambipolar trap.** Stupakov, G.V. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). Jun 1979. Translation of IYAF—78-94. 10p. P 02/MF A01.

Radial displacements Δr of particles upon reflection from the nonaxisymmetric mirror of an ambipolar trap may be manifested in enhanced plasma losses from the trap. The present paper examines the possibility of reducing these losses through special selection of the mirror magnetic field geometry, leading to a significant decrease in Δr. An equation that relates the intensities of the axisymmetric and quadrupole components of such a field has been obtained in the paraxial approximation.

53888 Simulation of compact breakeven and ignition experiments. Bittoni, E.; Taroni, A. (Comitato Nazionale per l'Energia Nucleare, Bologna (Italy). Centro di Calcolo); Coppi, B. (Massachusetts Inst. of Tech., Cambridge (USA)); Haegi, M. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy)). pp 117-141 of Theoretical and computational plasma physics. Vienna; IAEA (1978).

From College in theoretical and computational plasma physics; Trieste, Italy (22 Mar 1977).

An analysis is presented that explores the range of parameters for which breakeven or ignition conditions can be reached in compact D-T burning devices, called Ignitors.

53889 Theory for steady state of r.f. plugging. Watanabe, T. (Nagoya Univ. (Japan). Inst. of Plasma Physics); Hojo, H.; Nishikawa, K. (Hiroshima Univ. (Japan). Faculty of Science). pp 441-467 of Theoretical and computational plasma physics. Vienna; IAEA (1978).

From 3. KIEV conference; Trieste, Italy (5 Apr 1977).

General formulation of the steady state obtained by an r.f. confinement of plasma is presented within the framework of the collisionless two-fluid model. The effect of plasma flow is taken into account by introducing modified scalar and vector potentials, modification being due to the centrifugal force and the Coriolis force, respectively. A simple variation principle is derived to determine the steady state using the Clebsch representation for the modified vector potential. For the axisymmetric case, expressions or equations for quasilinear modification of the average quantities are derived in the weak-field approximation. Results of numerical calculation for the r.f. plugging applied to a line cusp are presented and discussed.

PLASMA DIAGNOSTICS

53890 (CONF-790585—1) **Progress in extending neutral-particle detection down to 10 eV using a Cs heat pipe for electron detachment.** Barnett, C.F.; Ray, J.A. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 11p. P 02/MF A01.

From DOE workshop on plasma wall interactions; Germantown, MD, USA (31 May 1979).

Results obtained from experiments to develop a neutral-particle analyzer using a cesium (Cs) heat pipe for electron detachment are described. The Cs heat pipe analyzer, which provides a high conversion efficiency for neutral hydrogen to H^-, is discussed in detail. Also considered are the development of a compact velocity-energy analyzer for determining the energies of impurities escaping from the EBT plasma and the development of an absolute H^0 detector using secondary negative emission from a Cu target. The assembly of these various components to achieve a low-energy analyzer is illustrated. (SPH)

53891 (CONF-790585—2) **Diagnostic neutral beams for spectroscopic studies of impurities by charge-transfer reactions.** Isler, R.C.; Lyon, J.F. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 6p. P 02/MF A01.

From DOE workshop on plasma wall interactions; Germantown, MD, USA (31 May 1979).

Charge-transfer reactions between hydrogen atoms and impurities are considered as a means for measuring the concentrations of fully stripped ions which exist throughout the volume of a confined plasma. An example is presented of a measurement of O^{8+} from the ISX-B tokamak where a heating neutral beam provides a source of neutral hydrogen in the plasma center. The possibility of more systematic analysis with better spatial resolution using a diagnostic beam is considered.

53892 (RL—78-095) **Dynamics of laser produced implosion of gas filled microballoon targets.** Evans, R.G.; Key, M.H.; Nicholas, D.J. (Science Research Council, Chilton (UK). Rutherford Lab.). 1978. 24p. (CONF-780811—37). U 03/MF A01.

From 7. conference on plasma physics and control; Innsbruck, Austria (23 Aug 1978).

Laser produced compression of gas filled microballoon targets has been produced by a two beam Nd:glass laser with energies of up to 40 Joule per beam in a 100 psec pulse. The compressed plasma has been diagnosed by space resolved, time integrated X-ray spectroscopy and by observation of D-T fusion reaction products. Time resolved measurements of the implosion dynamics have been made by X-ray streak photography with a time resolution of 20 psec and in a separate experiment by pulsed X-ray shadowgraphy (or radiography) with a time resolution of 100 psec. Evidence is presented for hydrodynamic instability and shell break-up in an exploding pusher implosion of a layered microballon. A multi-layer plane target experiment has yielded a quantitative measurement of laser energy deposited into fast electrons.

53893 (IPF—77-6(preprint)) **Analysis of optical mixing in plasma scattering experiments.** Holzhauer, E.; Massig, J.H. (Stuttgart Univ. (TH) (Germany, F.R.). Inst. fuer Plasmaforschung). [nd]. 22p. U 03/MF A01.

Light scattering from plasma density fluctuation using a coherent detection system is analyzed to obtain the resolution in real space and k-space. The results are applied to the case of forward scattering experiments with CO_2-lasers.

PLASMA KINETICS - GENERAL

53894 (CONF-790552—1) **Spectral excitation due to charge transfer.** Isler, R.C. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 4p. P 02/MF A01.

From US-Japan joint seminar on plasma spectroscopy; Kyoto, Japan (7 May 1979).

This paper briefly describes the physical picture of the charge exchange mechanism at low collision energies (relative velocities less than 2×10^8 cm/sec) and discusses modifications to this picture for intermediate collision energies. Examples of spectroscopic studies are presented from both atomic beam research and from plasma studies in tokamaks. The cross section for charge exchange at low energies is shown to follow from a quasi-molecule approximation. This approach is noted to fail at energies of neutral beam particles.

53895 (UEC-S—003/78) **Anomalous plasma resistivity in pre-pulsed flashlamp discharges.** Galvao, R.M.O.; Marotta, A. (Universidade Estadual de Campinas (Brazil). Inst. de Fisica). [nd]. 7p. U 02/MF A01.

It is shown that the V-i characteristic of discharges in flashlamps operating in the pre-pulsed mode at high current densities follows the relationship V= K$_0$i sup(0,85). This result is interpreted in terms of the Sagdeev-Galeev anomalous resistivity due to current-driven ion acoustic turbulence.

PLASMA KINETICS - EXPERIMENTAL

53896 (CEA-R—4903) **Experimental investigation of the plasma focus discharge.** Nazet, Christian. (CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France); Paris-11 Univ., 91 - Orsay (France)). Feb 1978. 175p. (In French). U 09/MF A01.

One reports the main experimental results obtained on low current level Focus discharges: 200 kA and 50 kA. Neutron and X-ray scaling laws from 50 kA up to 2500 kA have been established by taking into account all the results obtained at the Centre d'Etudes de Limeil. These scaling laws show the great interest of a 10 MA Plasma Focus device. To achieve this high current level, one present the experimental study of an explosive current generator driven plasma Focus.

53897 (COO—2456-T9) **Quarterly status report: high-beta tokamak research, 1 July—30 September 1978.** Gross, R.A. (Columbia Univ., New York (USA). Dept. of Applied Physics and Nuclear Engineering). 6 Oct 1978. Contract EY-76-S-02-2456. 4p. P 02/MF A01.

Progress on high-beta tokamak research at Columbia University during the period 1 July through 30 September 1978 is reported. Experimental observations on Torus-2 and Torus-1 are summarized. Hot plasma configurations have been confirmed experimentally on Torus-2. Engineering difficulties with the capacitor bank systems for Torus-2 are mentioned and the acquisition of 8-bit, 20 MHz digitizers is noted. Budget, personnel and capital equipment purchases are discussed. Conference and meeting attendance is itemized.

53898 (COO—2456-T10) **Quarterly status report: high-beta tokamak research, 1 October—31 December 1978.** Gross, R.A. (Columbia Univ., New York (USA). Dept. of Applied Physics and Nuclear Engineering). 22 Dec 1978. Contract EY-76-S-02-2456. 5p. P 02/MF A01.

Progress during the quarter from 1 October—31 December 1978 on high-beta tokamak research at Columbia University is reported. Activities discussed include experimental observations of plasma position and toroidal beta on Torus-2 and Torus-1 and various engineering and maintenance problems. Budget and personnel considerations are discussed and capital equipment purchases are itemized. Various lectures and trips are reported.

53899 (COO—2765-11) **Study of the acceleration, focussing and bunching of ions by electronic space charge for pellet fusion. Quarterly progress report, 1 February—30 April 1979.** Verdeyen, J.T. (Illinois Univ., Urbana (USA). Gaseous Electronics Lab.). 24 Apr 1979. Contract EY-76-S-02-2765. 4p. P 02/MF A01.

The feasibility of using electrostatic space-charge fields to extract, accelerate, focus and bunch ions from a background plasma onto a pellet target is considered experimentally. The efficient extraction and acceleration of ions from a background plasma nearly to full anode potential is reported, and preliminary evidence of bunching and focussing is indicated. Methods are discussed for obtaining a stable plasma at low enough pressures to reduce the formation of doubly ionized helium and for improving the noise to signal ratio on the ion current probe. Present efforts to consistently reproduce a sufficiently dense background plasma so that time-of-flight data can be obtained are mentioned.

53900 (EUR-CEA-FC—937) **High frequency energy generation through the interaction of a helical beam with the azimuthal electric field of a resonating structure.** Le Gardeur, R. (Association Euratom-CEA sur la Fusion, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Oct 1977. 94p. (In French). U 06/MF A01.

High frequency energy production from cyclotron electrons orbiting in a steady state magnetic field was studied, the major difficulties being the proper phasing of the electrons, necessary for the generation of the energy, and the perturbation caused by space charge, due to the presence of the electrons in the beam. Nevertheless, as the oscillating electric field present in the resonant cavity, field interacting with the electron beam consisting of cyclotron orbiting electrons, is azimuthal, the amplitude of the field rising with the distance from the axis of the electromagnetic cavity, the phasing of the electrons, permitting high frequency energy generation, is facilitated. A description is given of the physical mechanism result-

ing in the generation of high frequency energy, followed by a detailed theoretical development, without consideration of the perturbations caused by space charge, due to the electrons present in the beam, and, eventually, by the relativistic change in mass (subjects treated in a second part of this report). At long wave lengths, a pseudo-cavity, whose dimensions are less than the wave length of the generated energy, permits, by employing the same physical mechanism as described above, the production of energy in the decimetric and metric wave bands.

53901 (EUR-CEA-FC—945) **Identification of forbidden lines in the soft X-ray spectrum of the TFR Tokamak.** Klapisch, M.; Schwob, J.L.; Finkenthal, M.; Fraenkel, B.S.; Egert, S.; Bar-Shalom, A.; Breton, C.; Michelis, C. de; Mattioli, M. (Association Euratom-CEA sur la Fusion, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Jan 1978. 16p. (In French). U 02/MF A01.

Two quite intense lines, at 58.832 A and 57.927 A appearing in the TFR Tokamak are attributed to E2 transitions $3d^{10}$ - $3d^9$ 4s (J=2) of MoXV. This classification is based on the comparison between experimental and computed wavelengths and intensities of these lines in the Tokamak plasma. The great influence of cascades on the intensities is shown. It is shown that similar lines for other ionization stages of Mo should be much weaker.

53902 (PPPL—1575) **Depth distributions of low energy deuterium implanted into silicon as determined by SIMS.** Magee, C.W.; Cohen, S.A.; Voss, D.E.; Brice, D.K. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Aug 1979. Contract EY-76-C-02-3073. 15p. P 02/MF A01.

Secondary ion mass spectrometry (SIMS) has been used to determine depth profiles of deuterium implanted into single crystal silicon targets at energies between 0.1 and 5 keV. The atomic mixing inherent in the sputtering process, which directly affects depth resolution, has been reduced by using a bombarding particle of low energy and high Z impacting the sample at a large angle relative to the surface normal (3 keV, Cs^+, impacting at 60^0). Using this procedure, depth resolution of 20 A at a depth of 800 A has been obtained in depth profiling of Ta_2O_5 on Ta. Mean projected range and straggling of the implant profiles are in good agreement with calculations when irradiations are performed at 11^0 from the normal to the (100) plane to prevent channeling. The saturation density of trapped deuterium has also been determined to be 1.4×10^{22} D/cm^3.

PLASMA KINETICS - THEORETICAL

REFER ALSO TO CITATION(S) 53940

53903 (COO—2200-11) **Computer simulation of kinetic properties of plasmas. Progress report, October 1, 1978-June 30, 1979.** Denavit, J. (Northwestern Univ., Evanston, IL (USA)). 30 Jun 1979. Contract EY-76-S-02-2200. 7p. P 02/MF A01.

The research is directed toward the development and testing of new numerical methods for particle and hybrid simulation of plasmas, and their application to physical problems of current significance to Magnetic Fusion Energy. During the present period, research on the project has been concerned with the following specific problems: (1) Computer simulations of drift and dissipative trapped-electron instabilities in tokamaks, including radial dependence and shear stabilization. (2) Long-time-scale algorithms for numerical solutions of the drift-kinetic equation. (3) Computer simulation of field-reversed ion ring stability. (4) Nonlinear, single-mode saturation of the bump-on-tail instability.

53904 (EUR-CEA-FC—944) **Electron cyclotron emission from thermal plasmas.** Fidone, I.; Granata, G. (Association Euratom-CEA sur la Fusion, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Feb 1978. 29p. U 03/MF A01.

Electron cyclotron radiation from a warm inhomogeneous plasma is investigated. A direct calculation of the emissive power of a plasma slab is performed using Rytov's method and the result is compared with the solution of the transfer equation. It is found that, for arbitrary directions of emission, the two results differ, which reflects the fact that Kirchhoff's law is not generally obeyed.

53905 (EUR-CEA-FC—947) **Numerical simulation of the impurity peak positions in TFR 400 discharges.** (Association Euratom-CEA sur la Fusion, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Mar 1978. 27p. (In French). U 03/MF A01.

A numerical code which solves evolution equations for the densities of each ionization level of oxygen and molybdenum is used for simulating the stationary state of T.F.R. discharge. Using neo classical (Pfirsch-Schluter) fluxes and anomalous 'spreading' fluxes, gives the positions of oxygen peaks inwardly displaced from those calculated using the coronal equilibrium model, in reasonable agreement with the experimental measurements. Reasonable agreement with the experiment for the emitted photon is also found. In addition the positions of the maxima of the molybdenum peaks are in agreement with both the coronal equilibrium model and experimental observations.

53906 **Some statistical aspects of partially ionized systems.** Ecker, G. (Ruhr-Univ., Bochum (Germany, F.R.)). pp 259-279 of Theoretical and computational plasma physics. Vienna; IAEA (1978).

From 3. KIEV conference; Trieste, Italy (5 Apr 1977).

The statistical problem discussed is the distribution on the various partical states of partially ionized system. Those are: a) the equilibrium state, b) the states with non-equilibrium radiation, and c) the stationary general non-equilibrium state.

53907 (LA-UR—79-2344) **Global properties of ohmically heated reversed-field pinches.** Gerwin, R.A. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 14p. P 02/MF A01.

The simultaneous requirements of power balance and pressure balance have been considered. The treatment generalizes the Pease-Braginskii pinch current limit by including toroidal magnetic field, anomalous resistivity, nonradiative losses, and time-dependent fields. The rise of the temperature to a state of power balance proves to be amenable to a very simple and unified description. Finally, the practical parameter windows implied by the joint action of power balance and pressure balance are displayed.

53908 (LA-UR—79-2368) **Physical conditions in reversed field pinches and theta pinches as inferred from simulations.** Sgro, A. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 15p. P 02/MF A01.

The nature of the transport in certain pinches is investigated by comparing experimental data with computational predictions of the AURORA code. It is shown that anomalous resistivity and anomalous thermal conduction are present during the implosion phase of the ZT-S reversed field pinch, and that as equilibrium is approached the anomalous contribution to the transport coefficients decrease. Evidence is presented indicating that a low density wall emitted plasma occupies the region between the main plasma column and the wall. Simulations of a θ-pinch show that anomalous heating of the ions due to microturbulent fields makes a noticeable contribution to the ion energetics.

53909 (ORNL/TM—6914) **Fusion reactivity graphs and tables for charged particle reactions.** McNally, J.R. Jr.; Rothe, K.E.; Sharp, R.D. (Oak Ridge National Lab., TN (USA)). Aug 1979. Contract W-7405-ENG-26. 46p. P 03/MF A01.

Graphs and tables are presented on 31 light isotope fusion reaction parameters [$<\sigma v>$, $n<\sigma v>$, $<\sigma v>Q/sub +/$, $n<\sigma v>Q/sub +/$ (for $n = 10^{20}$ fuel ion species/m^3 and Q/sub +/ = energy release in charged particles)] in the kinetic temperature range 1 to 1000 keV.

53910 (PPPL—1581) **Particle diffusion by magnetic perturbations of axisymmetric geometries.** Mynick, H.E.; Krommes, J.A. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Aug 1979. Contract EY-76-C-02-3073. 15p. P 02/MF A01.

The quasilinear theory of collisionless test particle diffusion in stochastic magnetic fields is extended to include the effects of finite gyroradius, particle drifts, and magnetic trapping. Runaway confinement is substantially improved relative to earlier estimates which assumed that particles exactly followed field lines. Trapped particles are not expected to be stochastic.

53911 (UCRL-Trans—11493) **Hydrodynamic equilibrium of plasma in an ambipolar trap.** Stupakov, G.V. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). Jun 1979. Translation of IYAF—78-93. 25p. P 02/MF A01.

Hydrodynamically equilibrium plasma configurations in an ambipolar trap are investigated. It is shown that with allowance for the finite, albeit small, value of β, the constant pressure surfaces on the long part of the center mirror cell are distorted and in general are not circular cylinders. These effects of the distortion of the surfaces p = const can be reduced through special selection of the mirror field.

53912 **Turbulence, clumps and the Bethe-Salpeter equation.** Krommes, J.A. (Institute for Advanced Study, Princeton, NJ (USA)). pp 405-417 of Theoretical and computational plasma physics. Vienna; IAEA (1978).

From 3. KIEV conference; Trieste, Italy (5 Apr 1977).

The theory of two-body correlations (Bethe-Salpeter equation) is used to unify renormalized plasma weak turbulence theory, particle clumping, and the direct interaction approximation.

53913 **Single-particle behaviour in plasmas.** McNamara, B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). pp 5-25 of Theoretical and computational plasma physics. Vienna; IAEA (1978).

From College in theoretical and computational plasma physics; Trieste, Italy (22 Mar 1977).

This paper discusses essentially the motion of charged particles in electromagnetic fields. Difficult methods of averaging are explained and applied to calculation of constants of motion. The breakdown of these constants and its consequences on fusion is analyzed.

53914 Theory for correlations in strongly turbulent plasmas. Misguich, J.H. (Association Euratom-CEA sur la Fusion, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee); Balescu, R. (Brussels Univ. (Belgium). Faculte des Sciences). pp 281-294 of Theoretical and computational plasma physics. Vienna; IAEA (1978).

From 3. KIEV conference; Trieste, Italy (5 Apr 1977).

A kinetic theory for binary correlations in turbulent plasmas is presented which is an extension of the Dupree-Weinstock method. It is shown that the effects associated with "clumps" can be obtained as a lowest approximation of this general theory.

53915 Evolution of tokamak plasma equilibria. Pereversev, G.V.; Shafranov, V.D.; Zakharov, L.E. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). pp 469-481 of Theoretical and computational plasma physics. Vienna; IAEA (1978).

From 3. KIEV conference; Trieste, Italy (5 Apr 1977).

The problem of the evolution of the magnetic configuration of a toroidal tokamak-type system is shown to be soluble separately from the plasma diffusion process, in the case of a prescribed plasma pressure. In other words, to calculate both poloidal and toroidal field diffusion, a knowledge of the 'effective' transverse conductivity sigmasub(perpendicular) (which is responsible for anomalous diffusion) is not necessary. The knowledge of sigmasub(parallel) is essentially sufficient. Since the latter is described by the classical Spitzer formula for a stable stage of the discharge, the problem of evolution acquires a reliable basis.

53916 Equilibrium relations in the presence of arbitrary plasma diffusion in axisymmetric configurations. Pfirsch, D. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). pp 49-58 of Theoretical and computational plasma physics. Vienna; IAEA (1978).

From College in theoretical and computational plasma physics; Trieste, Italy (22 Mar 1977).

A condition for general axisymmetric diffusive equilibria that relates the outward diffusion to the toroidal ament density is derived. In an approximate version, it requires that some effective diffusion velocity vsub(D)sup(*) must not exceed the poloidal magnetic diffusion velocity vsub(m). Relevant consequences follow in the anomalous diffusion regime if diffusion is caused by an anomalous parallel electron viscosity instead of an anomalous perpendicular resistivity. In the former case, vsub(D)sup(*) equals the real diffusion velocity vsub(D), and an anomalous bootstrap current arises which leads to rather low upper limits for βsub(p). If the usual trapped ion or Bohm diffusion is assumed to be caused by enhanced viscosity, no stationary high-temperature equilibria would be possible in a system governed by the appropriate diffusion law.

53917 Collisional transport. Pfirsch, D. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). pp 59-76 of Theoretical and computational plasma physics. Vienna; IAEA (1978).

From College in theoretical and computational plasma physics; Trieste, Italy (22 Mar 1977).

Collisional particle and heat transport is treated in plane and toroidal geometry. In particular, temperature gradient effects on impurity diffusion - so-called temperature screening - are considered for the different collisional regimes. The existence of quasistationary self-consistent tokamak equilibria with finite resistivity and a possible limitation of the maximum β caused by particle diffusion is discussed.

53918 Equilibrium of a toroidal plasma. Sudano, J.P.; Goes, L.C.S. (Centro Tecnico Aeroespacial, Sao Jose dos Campos (Brazil). Inst. Tecnologico de Aeronautica). pp 483-490 of Theoretical and computational plasma physics. Vienna; IAEA (1978).

From 3. KIEV conference; Trieste, Italy (5 Apr 1977).

A class of exact MHD toroidal equilibrium solutions is found which holds good for arbitrary aspect ratio. The main features of this solution are: (a) near the magnetic axis the flux function surfaces are confocal ellipses of known eccentricities; and (b) far from the magnetic axis there exists a separatrix with a form similar to a lemniscate.

53919 (IPF—77-7) Basic physical phenomena, neutron production and scaling of the dense plasma focus. Kaeppeler, H.J. (Stuttgart Univ. (TH) (Germany, F.R.). Inst. fuer Plasmaforschung). [nd]. 24p. U 03/MF A01.

This paper presents an attempt at establishing a model theory for the dense plasma focus in order to present a consistent interpretation of the basic physical phenomena leading to neutron production from both acceleration and thermal processes. To achieve this, the temporal history of the focus is divided into the compression of the plasma sheath, a quiescent and very dense phase with ensuing expansion, and an instable phase where the focus plasma is disrupted by instabilities. Finally, the decay of density, velocity and thermal fields is considered. Under the assumption that Io²/sigmaoRo² = const and to/Tc = const, scaling laws for plasma focus devices are derived. It is shown that while generally the neutron yield scales with the fourth power of maximum current, neutron production from thermal processes becomes increasingly important for large devices, while in the small devices neutron production from acceleration processes is by far predominant.

PLASMA INSTABILITIES

53920 (EUR-CEA-FC—938) Nonlinear calculations of MHD stability. 1. Stationary convective solutions. Maschke, E.K.; Paris, R.B.; Saramito, B. (Association Euratom-CEA sur la Fusion, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Feb 1978. 48p. (In French). U 04/MF A01.

A 2-dimensional single fluid MHD numerical code has been developed for the study of MHD modes in the presence of resistivity, viscosity and thermal conduction. In addition to these dissipative effects, the equations contain sources of heat and mass. As a first application of the code, stationary convective modes have been calculated in a cylindrical plasma layer with a density gradient and a magnetic field. The stability limit and the amplitude of the different stationary modes have been obtained and are found to be in good agreement with those predicted by the non-linear theory.

53921 (IAE—2955) Drift effects in the theory of MHD modes in a tokamak. Krymskii, A.M.; Mikhailovskii, A.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1978. 16p. (In Russian). U 02/MF A01.

Analytically studied is the influence of drift effects on ideal and resistive MHD modes of a tokamak. For realizing the role of the toroidal form, the plasma model described by two-liquid hydrodynamic equation is considered. In the framework of this model initial equations for MHD modes, analyzed in various limiting cases, are derived. In this case interiour kink model, disturbances of the Sidem type, resistive kink mode, g-mode and tiring mode are considered. Increments and boundaries of drift instabilities, connected with the above modes are found out. It is shown that account of toroidal form leads to essentially new effects, if there is plasma temperature gradient along with density gradient.

53922 (IAE—3007) General problems of the theory of helical modes in tokamaks and some applications. Mikhailovskii, A.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1978. 33p. (In Russian). U 03/MF A01.

A new method of studying tokamak helical instabilities is developed. An equation of small MHD oscillations written in covariant terms is derived. An "ideal" limit of the equation is considered, and its connection with the potential energy functional present in the energy method of MHD-instability investigation has been established. It is considered how with the help of covarient equation of small oscillations it is possible to obtain the known results concerning small-scale MHD perturbations. Derived are initial equations of the theory of the lowest helical modes of the tokamak with an arbitrary form of the cross section. It is shown how plasma inertia is taken into account in ideal MHD modes in a covariant way. The general theory developed is applied to the problem of ideal internal helical modes.

53923 (LA—7912-MS) Relativistic electron beam propagation: two-stream theory, January 1978-January 1979. Newberger, B.S. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 48p. P 03/MF A01.

Progress achieved in the theoretical understanding of the two-stream instability as it pertains to the propagation of relativistic electron beams through low pressure neutral gases is presented. Research has been performed on both aspects of the stability issue: linear stabilization of the two-stream mode and the nonlinear state of an unstable system.

53924 (PPPL—1562) Theory of drift-wave eigenmodes in toroidal plasmas. Chen, L.; Cheng, C.Z. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jul 1979. Contract EY-76-C-02-3073. 39p. P 03/MF A01.

The eigenmode equation describing ballooning drift waves in toroidal plasmas is analyzed using the WKB method. Two branches of eigenmodes are identified. One is slab-like and the other is a new branch induced by the finite toroidicity. The slab-like eigenmodes correspond to unbounded states and experience finite shear damping. The toroidicity-induced eigenmodes, however, correspond to local quasibounded states with negligible shear damping. Both branches of

eigenmodes may exist simultaneously. Corresponding analytical theories are also presented.

53925 (PPPL—1570) **Absolute dissipative drift-wave instabilities in tokamaks.** Chen, L.; Chance, M.S.; Cheng, C.Z. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jul 1979. Contract EY-76-C-02-3073. 17p. P 02/MF A01.

Contrary to previous theoretical predictions, it is shown that the dissipative drift-wave instabilities are absolute in tokamak plasmas. The existence of unstable eigenmodes is shown to be associated with a new eigenmode branch induced by the finite toroidal couplings.

53926 (PPPL—1573) **Universal mode revisited.** Kaw, P.K.; Guzdar, P.N. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Aug 1979. Contract EY-76-C-02-3073. 14p. P 02/MF A01.

Our present understanding of the theory of universal eigenmodes in a collisionless plasma slab with magnetic shear, is reviewed and critically examined.

53927 (PPPL—1579) **Unstable universal drift eigenmodes in toroidal plasmas.** Cheng, C.Z.; Chen, L. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Aug 1979. Contract EY-76-C-02-3073. 16p. P 02/MF A01.

The eigenmode equation describing ballooning collisionless drift instabilities is analyzed both analytically and numerically. A new branch of eigenmodes, which corresponds to quasi-bound states due to the finite toroidicity, is shown to be destabilized by electron Landau damping for typical Tokamak parameters. This branch cannot be understood by the strong coupling approximation. However, the slab-like (Pearlstein-Berk type) branch is found to remain stable and experience enhanced shear damping due to finite toroidicity.

53928 **Stable MHD equilibria.** Lortz, D.; Nuehrenberg, J. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). pp 305-320 of Theoretical and computational plasma physics. Vienna; IAEA (1978).

From 3. KIEV conference; Trieste, Italy (5 Apr 1977).

This paper deals with the stability criteria and their use as a tool for the construction of stable magnetohydrostatic equilibria.

53929 **Parametric excitation.** Nishikawa, K. (Hiroshima Univ. (Japan). Faculty of Science). pp 173-195 of Theoretical and computational plasma physics. Vienna; IAEA (1978).

From College in theoretical and computational plasma physics; Trieste, Italy (22 Mar 1977).

General aspects of the theory of parametric instabilities are surveyed. First, the basic concept of the parametric excitation is explained and its characteristic features are described with the use of the Mathieu equation model. Two specific types of instabilities - resonant type and non-resonant type purely growing instabilities - are specifically discussed. The theory is then extended to a general three-mode coupling problem in a uniform medium and a physical mechanism of the instability is presented. A brief classification of various instabilities is also presented. Finally, some geometrical effects on the resonant decay instability are discussed based on physical rather than mathematical arguments, with particular reference to the absolute versus convective types of instabilities.

53930 **Linear and non-linear calculations of the tearing mode.** Schnack, D.; Killeen, J. (California Univ., Livermore (USA). Lawrence Livermore Lab.; California Univ., Davis (USA). Dept. of Applied Science). pp 337-360 of Theoretical and computational plasma physics. Vienna; IAEA (1978).

From 3. KIEV conference; Trieste, Italy (5 Apr 1977).

The results are presented of the application of a two-dimensional, non-linear MHD computer code to the tearing mode. For the case of the sheet pinch, linear growth rates are obtained and non-linear behaviour investigated. In addition, the linear and non-linear behaviour of the mode is studied for the case when two singular surfaces are in close proximity. For this double tearing mode, it is found that the linear growth rate is greatly enhanced over that of the single tearing mode. The mode is followed into the non-linear regime and is found to result in magnetic field configurations which could lead to enhanced diffusion. It is found that approximately 10% of the energy released goes into kinetic energy.

53931 **Dissipative MHD stability.** Tasso, H. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). pp 321-335 of Theoretical and computational plasma physics. Vienna; IAEA (1978).

From 3. KIEV conference; Trieste, Italy (5 Apr 1977).

A short survey of the literature on dissipative magnetohydrodynamic instabilities is given as introduction. A mathematical technique allowing 'energy principles' is developed and applied to toroidal equilibria and to cylindrical tokamak-like equilibria, taking into account resistivity and the full macroscopic tensor, i.e. finite Larmor radius (FLR) effects and viscosity. This allows general statements to be made about MHD stability in the presence of viscosity and FLR, and permits, without much computation, a qualitative and comparative study of resistive perturbations under the influence of FLR and viscosity. Applications to tokamak observations are also sketched. Finally, it is proved that the stability of dissipative time-dependent force-free fields can be analysed by a simple functional containing only the perturbed vector potential. This proof is valid even if all non-ideal effects of the two-fluid theory are considered. The conclusion contains a discussion of the open problems, and suggestions are given for their solution.

53932 **Non-linear numerical algorithms for studying tearing modes.** Waddell, B.V.; Rosenbluth, M.N. (Institute for Advanced Study, Princeton, NJ (USA)); Monticello, D.A.; White, R.B. (Princeton Univ., NJ (USA). Plasma Physics Lab.); Carreras, B. (Junta de Energia Nuclear, Madrid (Spain)). pp 79-91 of Theoretical and computational plasma physics. Vienna; IAEA (1978).

From College in theoretical and computational plasma physics; Trieste, Italy (22 Mar 1977).

The numerical methods that have recently been developed to study the non-linear evolution of tearing modes in tokamaks are summarized. The essential features of tearing modes can be described by the resistive MHD equations. The numerical algorithms described here are based on a reduced set of two-dimensional resistive MHD equations that are numerically tractable. Two distinct types of numerical methods are described in detail. In the first method, referred to as the MASSLESS algorithm, the inertia is neglected. On the other hand, in the second method, referred to as the MASS algorithm, the inertia is retained and consequently the scheme is capable of handling a larger variety of problems. Codes based on these two algorithms give similar results for the non-linear evolution of the $m=2$ tearing mode.

PLASMA WAVE PHENOMENA

53933 (COO—4631-6) **Experimental test of resonant absorption theory. Progress report, January 1, 1979-March 31, 1979.** Yablonovitch, E. (Harvard Univ., Cambridge, MA (USA)). Apr 1979. Contract ED-78-S-02-4631. 3p. P 02/MF A01.

The first measurements of the angular and energy spectrum of RA electrons and the first experiments on D_2 gas are reported.

53934 (LBL—9465) **Ray and wave optics of integrable and stochastic systems.** McDonald, S.W.; Kaufman, A.N. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1979. Contract W-7405-ENG-48. 12p. (CONF-7906106—1). P 02/MF A01.

From International workshop on intrinsic stochasticity in plasmas; Cargese, Corsica, France (18 Jun 1979).

The generalization of WKB methods to more than one dimension is discussed in terms of the integrability or non-integrability of the geometrical optics (ray Hamiltonian) system derived in the short-wave approximation. In the two-dimensional case the ray trajectories are either regular or stochastic, and the qualitative differences between these types of motion are manifested in the characteristics of the spectra and eigenfunctions. These are examined for a model system which may be integrable or stochastic, depending on a single parameter.

53935 (PPG—422) **Observation of stimulated brillouin scattering in a microwave plasma interaction emperiment.** Huey, H.E.; Mase, A.; Luhmann, N.C. Jr. (California Univ., Los Angeles (USA)). Jul 1979. Contract EY-76-C-03-0010-021. 13p. P 02/MF A01.

Stimulated Brillouin scattering of microwave radiation is investigated in an underdense laboratory plasma. The energy and momentum selection rules are seen to be satisfied for a variety of incident wavelengths ($\lambda_0 = 3 \sim 10$ cm) and ion species (He, Ne, Ar and Kr). The threshold power, growth rate and scattered power appear to be consistent with the finite interaction length theory. Saturation of the backscatter is observed and compared with existing theories.

53936 **Growing second-order wave in the Landau-Vlasov problem.** Best, R.W.B. (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Inst. voor Plasma-Fysica). pp 295-301 of Theoretical and computational plasma physics. Vienna; IAEA (1978).

From 3. KIEV conference; Trieste, Italy (5 Apr 1977).

A short derivation is given of the relation between the Van Kampen mode and the dielectric function for a Vlasov plasma. A numerical example is given of a second-order growing low-frequency wave.

53937 **Problem of collapse in plasmas.** Buti, B. (Physical Research Lab., Ahmedabad (India)). pp 391-404 of Theoretical and computational plasma physics. Vienna; IAEA (1978).

From 3. KIEV conference; Trieste, Italy (5 Apr 1977).

The phenomena of the collapse of plasma waves are discussed from fluid-model and kinetic-model points of view.

53938 Hybrid simulations of quasineutral phenomena in magnetized plasma. Byers, J.A.; Cohen, B.I.; Condit, W.C.; Hanson, J.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). pp 197-203 of Theoretical and computational plasma physics. Vienna; IAEA (1978).

From College in theoretical and computational plasma physics; Trieste, Italy (22 Mar 1977).

A new class of numerical algorithms is presented for computer simulation of low-frequency electromagnetic and electrostatic phenomena in magnetized plasma. Maxwell's equations are solved in the limits of quasineutrality and negligible transverse displacement current (Darwin's model). Electrons are modelled as a fluid with polarization effects ignored. Ions are described as particles.

53939 Kinetic theory of surface waves in semibounded plasmas. Sitenko, A.G. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). pp 145-172 of Theoretical and computational plasma physics. Vienna; IAEA (1978).

From College in theoretical and computational plasma physics; Trieste, Italy (22 Mar 1977).

A kinetic theory of non-linear wave interaction in semibounded plasmas is developed for the specular reflection model. A kinetic field equation is derived on the basis of which resonant interaction of surface waves, causing decay and explosive instabilities, is investigated. Surface and volume fluctuations in semibounded non-equilibrium plasmas and time development of fluctuation spectra due to nonlinear wave interaction are considered. A kinetic equation for surface waves is derived and its possible applications to the description of wave scattering and radiation in semibounded plasmas are discussed.

53940 Statistical theory of strong Langmuir turbulence. Tsytovich, V.N. (AN SSSR, Moscow. Fizicheskij Inst.); Komilov, K.; Khakimov, F.Kh. (AN Tadzhikskoj SSR, Dushanbe. Fiziko-Tekhnicheskij Inst.). pp 373-389 of Theoretical and computational plasma physics. Vienna; IAEA (1978).

From 3. KIEV conference; Trieste, Italy (5 Apr 1977).

In this paper the authors present the basic equations and the analytical solution of the strong Langmuir turbulence theory. It also stressed to construct the theory from the very beginning on statistical bases.

53941 Adiabatic and non-adiabatic electron oscillations in a static electric field. Wahlberg, C. (Uppsala Univ. (Sweden)). pp 361-369 of Theoretical and computational plasma physics. Vienna; IAEA (1978).

From 3. KIEV conference; Trieste, Italy (5 Apr 1977).

The influence of a static electric field on the oscillations of a one-dimensional stream of electrons is investigated. In the weak-field limit the oscillations are adiabatic and mode coupling is negligible but becomes significant if the field is stronger. The latter effect is believed to be of importance for the stability of, e.g., potential double layers.

FUSION POWER PLANT TECHNOLOGY

53942 (PPPL—1550) **Workshop summaries for the third US/USSR symposium on fusion-fission reactors.** Jassby, D.L. (ed.). (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jul 1979. Contract EY-76-C-02-3073. 54p. (CONF-790117—(Summ.)). P 04/MF A01.

From 3. US/USSR symposium on fusion - fission hybrids; Princeton, NJ, USA (22 Jan 1979).

Workshop summaries on topics related to the near-term development requirements for fusion-fission (hybrid) reactors are presented. The summary topics are as follows: (1) external factors, (2) plasma engineering, (3) ICF hybrid reactors, (4) blanket design, (5) materials and tritium, and (6) blanket engineering development requirements. (MOW)

53943 (PPPL—1555) **Fusion-supported decentralized nuclear energy system.** Jassby, D.L. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Apr 1979. Contract EY-76-C-02-3073. 31p. (CONF-790803—36). P 03/MF A01.

From 14. intersociety energy conversion conference; Boston, MA, USA (5 Aug 979).

A decentralized nuclear energy system is proposed comprising mass-produced pressurized water reactors in the size range 10 to 300 MW (thermal), to be used for the production of process heat, space heat, and electricity in applications where petroleum and natural gas are presently used. Special attention is given to maximizing the refueling interval with no interim batch shuffling in order to minimize fuel transport, reactor downtime, and opportunity for fissile diversion. These objectives demand a substantial fissile enrichment (7 to 15%). The preferred fissile fuel is U-233, which offers an order of magnitude savings in ore requirements (compared with U-235 fuel), and whose higher conversion ratio in thermal reactors serves to extend the period of useful reactivity and relieve demand on the fissile breeding plants (compared with Pu-239 fuel). Application of the neutral-beam-driven tokamak fusion-neutron source to a U-233 breeding pilot plant is examined. This scheme can be extended in part to a decentralized fusion energy system, wherein remotely located large fusion reactors supply excess tritium to a distributed system of relatively small nonbreeding D-T reactors.

BLANKET ENGINEERING

REFER ALSO TO CITATION(S) 53199

53944 (PPPL—1571) **Ignition of an overheated, underdense, fusioning tokamak plasma.** Singer, C.E.; Jassby, D.L.; Hovey, J. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Aug 1979. Contract EY-76-C--02-3053. 28p. P 03/MF A01.

Methods of igniting an overheated but underdense D-T plasma core with a cold plasma blanket are investigated using a simple two-zone model with a variety of transport scaling laws, and also using a one-dimensional transport code. The power consumption of neutral-beam injectors required to produce ignition can be reduced significantly if the underdense core plasma is heated to temperatures much higher than the final equilibrium ignition values, followed by fueling from a cold plasma blanket. It is also found that the allowed impurity concentration in the initial hot core can be greater than normally permitted for ignition provided that the blanket is free from impurities.

53945 (WFPS-TME—104) **Reactor application of an improved bundle divertor.** Yang, T.F.; Ruck, G.W.; Lee, A.Y.; Smeltzer, G.; Prevenslik, T. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Fusion Power Systems Dept.). Nov 1978. Contract EG-77-C-02-4544. 100p. P 05/MF A01.

A Bundle Divertor was chosen as the impurity control and plasma exhaust system for the beam driven Demonstration Tokamak Hybrid Reactor - DTHR. In the context of a preconceptual design study of the reactor and associated facility a bundle divertor concept was developed and integrated into the reactor system. The overall system was found feasible and scalable for reactors with intermediate torodial field strengths on axis. The important design characteristics are: the overall average current density of the divertor coils is 0.73 kA for each tesla of toroidal field on axis; the divertor windings are made from super-conducting cables supported by steel structures and are designed to be maintainable; the particle collection assembly and auxiliary cryosorption vacuum pump are dual systems designed such that they can be reactivated alterntively to allow for continuous reactor operation; and the power requirement for energizing and operating the divertor is about 5 MW.

MAGNET COILS AND FIELDS

REFER ALSO TO CITATION(S) 53530, 53531, 53532, 53887

53946 (ANL/FPP/TM—121) **Safety of superconducting fusion magnets: twelve problem areas.** Turner, L.R. (Argonne National Lab., IL (USA)). May 1979. Contract W-31-109-ENG-38. 43p. P 03/MF A01.

Twelve problem areas of superconducting magnets for fusion reaction are described. These are: Quench Detection and Energy Dump, Stationary Normal Region of Conductor, Current Leads, Electrical Arcing, Electrical Shorts, Conductor Joints, Forces from Unequal Currents, Eddy Current Effects, Cryostat Rupture, Vacuum Failure, Fringing Field and Instrumentation for Safety. Each is described under the five categories: Identification and Definition, Possible Safety Effects, Current Practice, Adequacy of Current Practice for Fusion Magnets and Areas Requiring Further Analytical and Experimental Study. Priorities among these areas are suggested; application is made to the Large Coil Project at Oak Ridge National Laboratory.

53947 (CONF-790815—13) **Nitrogen-strengthened austenitic stainless steel for cryogenic magnet structures.** Mazandarany, F.N.; Parker, D.M.; Koenig, R.F.; Read, D.T. (General Electric Co., Schenectady, NY (USA); National Bureau of Standards, Boulder, CO (USA)). 1979. Contract W-7405-ENG-26. 20p. Dep. NTIS, PC A02/MF A01.

From Cryogenic engineering conference; Madison, WI, USA (21 Aug 1979).

In support of the magnet development effort, an extensive test program was initiated to verify expected base metal properties, to develop weld processes and to establish weld and base metal design allowables. This paper presents the results of the test program which involved testing and evaluation of 25 mm thick Type 316 LN plate, shielded metal arc weld (SMAW) deposits selected for structural welds, gas tungsten arc weld (GRAW) and gas metal arc weld (GMAW) deposits selected fo seal welds. The welding development effort including measurements of impact properties at RT and 77°K; chemical analyses; measurements of magnetic permeabilities and weld ferrite contents, metallographic and radiographic examinations

of welds were performed at the Materials and Processes Laboratory of General Electric in Schenectady, New York. Measurements of tensile, fracture toughness and fatigue crack growth rate (FCGR) properties from RT to 4°K were performed by the National Bureau of Standards in Boulder, Colorado.

53948 (COO—5069-12) **Magnetic surfaces, particle orbits and neutral injection in conventional and ultimate torsatrons.** Anderson, D.T.; Derr, J.A.; Kruckewitt, T.; Shohet, J.L.; Rehker, S.; Tataronis, J.A. (Wisconsin Univ., Madison (USA); Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.); New York Univ., NY (USA). Courant Inst. of Mathematical Sciences). 1979. Contract ER-78-S-02-5069. 4p. (CONF-790912—3). P 02/MF A01.

From 9. European conference on controlled fusion and plasma physics; Oxford, UK (17 Sep 1979).

Capabilities in fully non-axisymmetric numerical methods have resulted in a parametric study of various conventional and ultimate torsatron configurations. No superbananas are found in torsatrons without local magnetic wells. Neutral injection calculations show that, if the vacuum magnetic surfaces are well defined, tangential injection is very efficient.

53949 (NIIEFA-LM—0376) **Study on the strength of toroidal disk-type field windings for tokamak devices by the finite element method.** Sivkova, G.N.; Spirchenko, Yu.V.; Chvartatskii, R.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow; Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1978. 12p. (In Russian). U 02/MF A01.

The stress-strained state of toroidal disk-type field windings for tokamak devices is investigated on the basis of the plane problem solution of the elasticity theory by the finite element method (FEM). Using the numerical dimensions of the winding for the T-20 device the comparative analysis of the calculated results obtained by FEM with the results obtained by the construction mechanics is carried out. The comparison of the calculated results showed that the results are qualitatively identical. It indicates the wide possibilities of application of the rod theory methods for such problems in the estimated engineering calculations. However FEM permits to obtain a bidimensional strength field with an account of all the complicated circumstances (a disk cut, volume nonuniform loadings). In this case, for instance, the nonuniformly distributed contact pressure on the inductor is determined. It is important to know while working with it. The radial and tangential stresses are obtained.

POWER SUPPLIES, ENERGY STORAGE

53950 (LA—7928-MS) **Current redistribution in cables made of insulated, soldered, or oxidized strands.** Turck, B. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 21p. P 02/MF A01.

Current redistributions are compared in cables made of insulated strands, soldered, or oxidized strands and insulated strands with periodic joints. After discussing the different current redistributions in the cases of a rapidly changing current and a dc current, several particular situations are investigated: what happens if a strand is broken, or if a local normal zone appears that does not affect all the strands equally, the detection of this normal zone, and the influence of short circuits between strands.

53951 (ORNL/SUB—01617/12) **Development program for a 200 kW, cw, 28-GHz gyroklystron. Quarterly report No. 12, January—March 1979.** Jory, H.; Evans, S.; Hegji, S.; Shively, J.; Symons, R.; Taylor, N. (Varian Associates, Inc., Palo Alto, CA (USA)). 1979. Contract W-7405-ENG-26. 37p. P 03/MF A01.

The objective of this program is to develop a microwave amplifier or oscillator capable of producing 200 kW CW power output at 28 GHz. The use of the gyrotron or cyclotron resonance interaction is being pursued. Design changes, construction and testing of several CW oscillators is discussed. Tube number 4, which used a miter bend output system, was tested to 97.2 kW CW output at Varian. It was shipped to Oak Ridge and failed from rf heating damage to the collector ceramic insulator. Tube number 2 was rebuilt with a number of minor design changes. It produced 92.1 kW CW at Varian for a short time, but failed as a result of a vacuum leak at the output window. Construction and cold testing of tube number 5 are described. This tube uses an axisymmetric output waveguide with a taper to 5 in diameter for the collector region followed by a taper back down to 2.5 in diameter.

53952 (SAND—79-1246C) **PULSAR: an inductive pulse power source.** Cnare, E.C.; Brooks, W.P.; Cowan, M. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 4p. (CONF-790622—19). P 02/MF A01.

From Pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

The PULSAR concept of inductive pulsed power source uses a flux-compressing metallic or plasma armature rather than a fast opening switch to transfer magnetic flux to a load. The inductive store may be a relatively unsophisticated dc superconducting magnet since no magnetic energy is taken from it, and no large current transients are induced in it. Initial experimental efforts employed either expendable or reusable metallic armatures with a 200 kJ, 450 mm diameter superconducting magnet. Attention is now being focused on the development of much faster plasma armatures for use in larger systems of one and two meters diameter. Techniques used to generate the required high magnetic Reynolds number flow will be described and initial experimental results will be presented.

HEATING AND FUELING SYSTEMS

53953 (IAE—2993) **Dynamics of the component composition of a hydrogen beam in a hydrogen target.** Kulygin, V.M.; Panasenkov, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1978. 17p. (In Russian). U 02/MF A01.

To study the structure of a neutral beam (fast hydrogen atoms), injected into a thermonuclear installation the effect of the stripping target thickness on the beam composition is considered. On the base of cross-sections of elementary processes the calculations of hydrogen beam passing through the stripping target of molecular hydrogen within energy range from 5 to 160 keV are carried out. The dependence on the energy of equilibrium yield of fast hydrogen atoms is given. In beams with the energies $<= 40$ keV the presence of considerable quantity of fast hydrogen molecules with E_0 and 2/3 E_0 energies, where E_0 is the energy at the ion source outlet with target thickness up to $1x10^{16}$ cm^{-2} is shown.

53954 (ORNL/TM—6730) **Neutral beam energy and power requirements for expanding radius and full bore startup of tokamak reactors.** Houlberg, W.A.; Mense, A.T.; Attenberger, S.E. (Oak Ridge National Lab., TN (USA)). Sep 1979. Contract W-7405-ENG-26. 46p. P 03/MF A01.

Natural beam power and energy requirements are compared for full density full bore and expanding radius startup scenarios in an elongated plasma, The Next Step (TNS), as a function of beam pulse time and plasma density. Because of the similarity of parameters, the results should also be applicable to Engineering Test Facility (ETF) and International Tokamak Reactor (INTOR) studies. A transport model consisting of neoclassical ion conduction and anomalous electron conduction and diffusion based on ALCATOR scaling leads to average densities in the range $<n> \sim 0.8$ to 1.2×10^{14} cm^{-3} being sufficient for ignition. Neutral deuterium beam energies in the range 120 to 180 keV are adequate for penetration, with the required power injected into the plasma decreasing with increasing beam energy. The neutral beam power decreases strongly with increasing beam pulse length b/sub b/ until t/sub b/ exceeds a few total energy confinement times, yielding b/sub b/ $\cong$ 4 to 6 s for the TNS plasma.

53955 (WFPS-TME—79-015) **Analysis of a water moderated critical assembly with anisn-Vitamin C.** Green, L. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Fusion Power Systems Dept.). Mar 1979. Contract EG-77-C-02-4544. 29p. P 03/MF A01.

A tightly packed water moderated $^{233}UO_2$—ThO_2 critical assembly was analyzed with the Vitamin C library and the 1-D S/s n/ code, ANISN (S_8,P_3). The purpose of the study was to provide validation of this calculational model as applied to water-cooled hybrid fusion blankets. The quantities compared were the core eigenvalue and various activation shapes. The calculated eigenvalue was 1.02 +- 0.01. The ^{233}U fission and ^{232}Th capture shapes were found to be in good agreement (+-5%) with experiment, except near water—metal boundaries where differences up to 24% were observed. No such error peaking was observed in the ^{232}Th fast fission shape. We conclude that the model provides good volume averaged reaction rates in water-cooled systems. However, care must be exercised near water boundaries where thermally dependent reaction rates are significantly underestimated.

53956 **Two- and three-dimensional neutronics calculations for the tokamak fusion test reactor neutral beam injectors.** Santoro, R.T.; Lillie, R.A.; Alsmiller, R.G. Jr.; Barnes, J.M. (Oak Ridge National Lab., TN). *Nucl. Sci. Eng.;* **70**: No. 3, 225-242(Jun 1979).

Two-and three-dimensional radiation transport methods have been employed to estimate the nuclear performance of the neutral beam injectors being designed for the Tokamak Fusion Test Reactor. The nuclear heating rates and neutron and gamma-ray energy spectra have been calculated at various locations in a detailed calculational model of the injector using Monte Carlo methods. Calculations have also been carried out using discrete-ordinates methods to obtain estimates of these data in a two-dimensional model of the injector. The two-dimensional calculational procedure was developed as an analytic tool for more cost-efficient scoping and parametric studies of the effects of design changes on the injector performance due to the streaming of 14-MeV neutrons. The nuclear responses and spectra obtained using the two-dimensional calculational model agree with the more definitive data obtained using the three-dimensional model within a factor of ~ 5.

TRITIUM PROCESSING, ENVIRONMENT AND SAFETY

REFER ALSO TO CITATION(S) 53720

53957 (CONF-790803—38) **Tritium permeation through steam generator materials.** Bell, J.T.; Redman, J.D. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 21p. P 02/MF A01.

From 14. intersociety energy conversion conference; Boston, MA, USA (5 Aug 1979).

Various subjects related to tritium permeation through steam generator materials are discussed. Isotope effects based on protium and tritium permeabilities of nickel range from 1.36 at 500°K to 1.63 at 1000°K. Tritium permeation rates from a given quantity of T_2 molecules will be reduced by the addition of protium and/or deuterium to a point that the tritium rates approach an inverse 0.5 power dependence on the protium and/or deuterium pressures. The permeability constants and the permeation activation energies essentially are equal for several ferritic alloys, but these parameters are significantly different from those for several austentic type alloys. Oxide layers on construction alloys can reduce permeation rates by 2 to 3 orders of magnitude but information on this subject may not be applicable to operating steam generator systems. Recent results indicate that tritium permeation rates through oxide and glass materials are 0.5 rather than first power dependent on pressure.

INERTIAL CONFINEMENT TECHNOLOGY

REFER ALSO TO CITATION(S) 52722, 53543, 53878, 53952

53958 (BNL—50985) **Annual report of the Brookhaven National Laboratory Heavy Ion Fusion Project, 1 October 1977—1 October 1978.** (Brookhaven National Lab., Upton, NY (USA)). Feb 1979. Contract EY-76-C-02-0016. 12p. P 02/MF A01.

This report is divided into three parts. The first deals with the results of an analysis of the fusion problem in general, and heavy ion inertial fusion in particular. The second portion deals with the progress being made in the design and development of high current, high brightness pre-injectors and linear accelerators. The third deals with some experiments with space charge neutralization, bunching, etc.

53959 (LA-UR—79-1833) **Velocity requirements for one-dimensional targets.** Jarboe, T.R. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 13p. (CONF-790741—3). P 02/MF A01.

From DOE impact fusion workshop; Los Alamos, NM, USA (10 Jul 1979).

A simple zero dimensional model which includes thermal conduction, Bremsstrahlung, compressional heating, alpha heating, and wall movement losses is used to estimate the velocity necessary for a fusion reactor based on impact fusion. Simple 1D impact and spherical 3D shock heating and compression are considered. The results are that an absolute minimum of 6E7 cm/s is needed for the 1D case while 0.85E7 cm/s is needed in the 3D case. However 7E7 cm/s and 1.3E7 cm/s respectively look like good operating points.

53960 (LA-UR—79-1960) **Applications of the lots computer code to laser fusion systems and other physical optics problems.** Lawrence, G.; Wolfe, P.N. (Los Alamos Scientific Lab., NM (USA); Arizona Univ., Tucson (USA). Optical Sciences Center). 1979. Contract W-7405-ENG-36. 6p. (CONF-790529—7). P 02/MF A01.

From Conference on Optics; Los Alamos, NM, USA (23 May 1979).

The Laser Optical Train Simulation (LOTS) code has been developed at the Optical Sciences Center, University of Arizona under contract to Los Alamos Scientific Laboratory (LASL). LOTS is a diffraction based code designed to beam quality and energy of the laser fusion system in an end-to-end calculation.

53961 (LA-UR—79-2057) **Polishing large NaCl windows on a continuous polisher.** Williamson, R. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 8p. (CONF-790529—10). P 02/MF A01.

From Conference on Optics; Los Alamos, NM, USA (23 May 1979).

The Helios and Antares CO_2 fusion laser systems incorporate numerous large sodium chloride windows. These must be refinished periodically, making necessary a consistent and predictable polishing capability. A continuous polisher (or annular lap) which might at Kirtland's Developmental Optical Facility. Large NaCl windows had not been polished on this type of machine. The machine has proven itself capable of producing $\lambda/16$ figures at 633 nm (HeNe) with extremely smooth surfaces on glass. Since then, we have been working exclusively on NaCl optics. Due to different polishing parameters between NaCl and glass, and the slight solubility of the pitch in the slurry, this phase presents new problems. The work on glass will be reviewed. Results on NaCl to date will be reported. The potential of this type of machine relative to prisms, thin and irregularly shaped optics will be discussed.

53962 (LA-UR—79-2058) **Mirror quality required by the Antares laser system.** Sweatt, W.C. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 8p. (CONF-790529—8). P 02/MF A01.

From Conference on Optics; Los Alamos, NM, USA (23 May 1979).

The Antares laser system is a large (100 kJ) CO_2 pulse laser operating at 10.6 μm. The system has 72 beam lines, each with an aperture of 900 cm^2. The system will be composed primarily of large copper-faced mirrors whose principal dimensions range up to 65 cm. These mirrors will be single-point diamond turned (SPOT) at the Y-12 facility of Union Carbide Corporation in Oak Ridge, Tennessee. we have had to develop surface quality specifications for these mirrors. These specifications were initially set at 50 nm peak-to-valley (p-v) surface error for the microsurface over 0.5-mm areas and 500 nm (p-v) over the whole mirror surface. An attempt has been made to refine these specifications to a more physically meaningful set based on the performance of the system. The optical specification for Antares is that 80% of the energy from each beam should be deliverable inside a 400-μm circle. The diffraction limited focal spot is 160 μm across, so small amounts of low spatial frequency wavefront aberrations are acceptable. This is the figure error and can be represented by a best-fit fourth-order polynomial. It is specified separately from the higher spatial frequency subfigure errors that diffract light out of the 400-μm circle.

53963 (LA-UR—79-2089) **Development of Helios target insertion mechanism.** Day, R.D.; Cummings, C.E.; Tucker, H.E. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 6p. (CONF-791010—1). P 02/MF A01.

From Applied mechanisms conference; Denver, CO, USA (1 Oct 1979).

A system for precisely positioning a DT-filled target in the Helios target vacuum chamber is described. The target insertion mechanism (TIM), which is designed to insert either a target or a surrogate sphere into the vacuum chamber through an airlock to prevent loss of vacuum, is discussed in detail and its performance is evaluated.

53964 (LA-UR—79-2357) **Overview of systems requirements for impact fusion power.** Williams, J.M.; Booth, L.A.; Krakowski, R.A. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 22p. (CONF-790741—7). P 02/MF A01.

From DOE impact fusion workshop; Los Alamos, NM, USA (10 Jul 1979).

The development of impact fusion power reactor concepts is very limited at this time. Key systems factors in arriving at practical concepts will be conception of credible systems and subsystems which promise an acceptable overall energy balance and development of target/projectile designs and gain versus projectile energy curves which allow system design tradeoffs to be accomplished. Important system parameters will be subsystem efficiencies (particularly the accelerator), target/projectile gain as a function of target design, circulating power fraction or engineering gain, system pulse repetition rate, size/cost scaling of components, containment cavity design limits, maximum yield, minimum economical yield, minimum projectile velocity and energy, and overall economics. When more detailed conceptual designs are available, then system tradeoffs and performance optimization will be possible.

53965 (NRL-MR—4050) **Space charge limited transport and bunching of non K-V beams.** Haber, I. (Naval Research Lab., Washington, DC (USA)). 25 Jul 1979. Contract ES-77-A-01-6021. 12p. P 02/MF A01.

Particle simulations are used to examine the behavior of an intense beam propagating down an alternate gradient focusing channel. In order to examine the dependence of emittance growth on the particle distribution function, an initially low current, non K-V, matched distribution is established. The current is then slowly increased as the beam propagates down the channel. Differences are observed in both the current at which emittance growth begins, and the rate at which the emittance grows, when the form of the initial distribution is changed. But this emittance growth still limits the intensity of the beam being transported.

53966 (SAND—79-0385) **Studies of particle beam overlap and electron deposition in thin foils.** Halbleib, J.A.; Wright, T.P. (Sandia Labs., Albuquerque, NM (USA)). Mar 1979. Contract EY-76-C-04-0789. 42p. P 03/MF A01.

This report summarizes a somewhat diverse set of theoretical studies carried out in 1978 which were aimed at increasing our understanding of the physics of multiple-beam overlap and enhanced deposition in thin foils. The studies reported here involve electron and ion beam overlap in single and multiple cylindrical disks of channels, and single and multiple electron-beam deposition in thin foils. Some of the important consequences of these studies which

affect ongoing research are the scaling formula derived for overlap current density gain in cylindrical geometry, an understanding of the importance of electron drift motion in thin-foil-enhanced deposition, and the necessity of providing non-axial return current paths and magnetic isolation of disks in multiple-disk configurations.

53967 (SAND—79-0939) **GEPOIS: a two dimensional nonuniform mesh Poisson solver.** Quintenz, J.P.; Freeman, J.R. (Sandia Labs., Albuquerque, NM (USA)). Jun 1979. Contract EY-76-C-04-0789. 48p. P 03/MF A01.

A computer code is described which solves Poisson's equation for the electric potential over a two dimensional cylindrical (r,z) nonuniform mesh which can contain internal electrodes. Poisson's equation is solved over a given region subject to a specified charge distribution with either Neumann or Dirichlet perimeter boundary conditions and with Dirichlet boundary conditions on internal surfaces. The static electric field is also computed over the region with special care given to normal electric field components at boundary surfaces.

53968 (UCRL—82980) **Surface analytical problems in the laser fusion energy program at Lawrence Livermore Laboratory.** Meisenheimer, R.G.; Fischer, J.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Jul 1979. Contract W-7405-ENG-48. 17p. (CONF-7906101—1). P 02/MF A01.

From 7. Canadian seminar on surfaces; Pinawa, Manitoba, Canada (10 Jun 1979).

The Lawrence Livermore Laboratory is involved in a program to produce energy by the laser-induced fusion of microtargets. These laser systems have become very large and powerful. In Shiva, the amplifier rods common to smaller systems have been replaced with an array of large elliptical amplifier discs with major axes as large as 42 cm. Under the high power levels of these devices it is imperative that the optical surfaces remain scrupulously clean. All units are therefore cleaned, assembled, and operated under clean room conditions. In spite of such precautions, persistent problems arise. These can be grouped into three categories: (1) the appearance of unknown contaminants from unknown sources, (2) the transfer of material from one part of the assembly to another, and (3) laser beam damage to the optical surfaces. Theses problems and their resolution by surface analytical methods are discussed. In addition some unique problems associated with the very large sample sizes are described.

COMPONENT DEVELOPMENT AND MATERIALS TESTING

REFER ALSO TO CITATION(S) 53465

53969 (CONF-790125—77) **Compatibility of structural materials with fusion reactor coolant and breeder fluids.** DeVan, J.H. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 8p. P 02/MF A01.

From 1. topical meeting on fusion reactor materials; Miami Beach, FL, USA (29 Jan 1979).

Fusion reactors are characterized by a lithium-containing blanket, a heat transfer medium that is integral with the blanket and first wall, and a heat engine that couples to the heat transfer medium. A variety of lithium-containing substances have been identified as potential blanket materials, including molten lithium metal, molten LiF—BeF_2, Pb—Li alloys, and solid ceramic compounds such as Li_2O. Potential heat transfer media include liquid lithium, liquid sodium, molten nitrates, water, and helium. Each of these coolants and blankets requires a particular set of chemical and mechanical properties with respect to the associated reactor and heat engine structural materials. This paper discusses the materials factors that underlie the selection of workable combinations of blankets and coolants. It also addresses the materials compatibility problems generic to those blanket-coolant combinations currently being considered in reactor design studies.

53970 (CONF-790657—6) **Microstructural evolution during dual-ion irradiation of candidate fusion reactor materials.** Nolfi, F.V. Jr.; Ayrault, G. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 7p. P 02/MF A01.

From Conference on irradiation behavior of metallic materials for fast reactor core components; Corsica, France (5 Jun 1979).

Single- and dual-ion (heavy ions + ^3He) irradiations of Fe-20wt.%Ni-15wt.%Cr, V-15wt.%Cr and Ti-6wt.%Al-4wt.%V alloys have been performed over a range of temperatures and doses. Various features of microstructural evolution during irradiation are reported as determined by transmission electron microscopy and Auger spectroscopy investigations.

53971 (COO—4467-T1) **Irradiation response of materials. Quarterly technical progress report.** Spitznagel, J.A.; Choyke, W.J. (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). 15 Apr 1979. Contract EG-77-C-02-4467. 21p. P 02/MF A01.

In this program two ion accelerators are used to simultaneously focus a beam of helium ions and a second ion beam on targets of selected reactor structural alloys. The resulting microstructural changes are being studied by systematic variations in damage rate, irradiation temperature, fluence and appM helium/dpa ratio and will be compared and correlated with results from companion fission reactor and high energy neutron irradiation studies conducted elsewhere in the DOE program.

53972 (DOE/ET—0065/2) **Damage analysis and fundamantal studies. Quarterly progress report, April—June 1978.** (Department of Energy, Washington, DC (USA). Office of Fusion Energy). May 1979. 197p. P 09/MF A01.

This report is the second in a series of Quarterly Technical Progress Reports on Damage Analysis and Fundamental Studies (DAFS) which is one element of the Fusion Reactor Materials Program, conducted in support of the Magnetic Fusion Energy Program. This report is organized along typical lines in parallel to a Program Plan of the same title (to be published) so that activities and accomplishments may be followed readily relative to that Program Plan. Thus, the work of a given laboratory may appear throughout the report. Chapters 1 and 2 report topics which are generic to all of the DAFS Program: DAFS Task Group Activities and Irradiation Test Facilities, respectively. Chapters 3, 4, and 5 report the work that is specific to each of the subtasks around which the program is structured: A) Environmental Characterization, B) Damage Production, and C) Damage Microstructure Evolution and Mechanical Behavior.

53973 (DOE/ET—0065/3) **Damage analysis and fundamental studies. Quarterly progress report, July—September 1978.** (Department of Energy, Washington, DC (USA). Office of Fusion Energy). May 1979. 219p. P 10/MF A01.

This report is the third in a series of Quarterly Technical Progress Reports on Damage Analysis and Fundamental Studies (DAFS) which is one element of the Fusion Reactor Materials Program, conducted in support of the Magnetic Fusion Energy Program. This report is organized along topical lines in parallel to Section II, Damage Analysis and Fundamental Studies (DOE/ET-0032/2), of the Fusion Reactor Materials Program Plan so that activities and accomplishments may be followed readily relative to that Program Plan. Thus, the work of a given laboratory may appear throughout the report. Chapters 1 and 2 report topics which are generic to all of the DAFS Program: DAFS Task Group Activities and Irradiation Test Facilities, respectively. Chapters 3, 4, and 5 report the work that is specific to each of the subtasks around which the program is structured: A) Environmental Characterization, B) Damage Production, and C) Damage Microstructure Evolution and Mechanical Behavior.

53974 (DOE/ET—0065/4) **Damage analysis and fundamental studies. Quarterly progress report, October—December 1978.** (Department of Energy, Washington, DC (USA). Office of Fusion Energy). May 1979. 237p. P 11/MF A01.

This report is the fourth in a series of Quarterly Technical Progress Reports on Damage Analysis and Fundamental Studies (DAFS) which is one element of the Fusion Reactor Materials Program, conducted in support of the Magnetic Fusion Energy Program. This report is organized along topical lines in parallel to a Program Plan of the same title (to be published) so that activities and accomplishments may be followed readily relative to the Program Plan. Thus, the work of a given laboratory may appear throughout the report. Chapters 1 and 2 report topics which are generic to all of the DAFS Program: DAFS Task Group Activities and Irradiation Test Facilities, respectively. Chapters 3, 4, and 5 report the work that is specific to each of the subtasks around which the program is structured: A) Environmental Characterization, B) Damage Production, and C) Damage Microstructure Evolution and Mechanical Behavior.

53975 (DOE/ET—0065/5) **Damage analysis and fundamental studies. Quarterly progress report, January—March 1979.** (Department of Energy, Washington, DC (USA). Office of Fusion Energy). May 1979. 270p. P 12/MF A01.

This report is the fifth in a series of Quarterly Technical Progress Reports on Damage Analysis and Fundamental Studies (DAFS) which is one element of the Fusion Reactor Materials Program, conducted in support of the Magnetic Fusion Energy Program. This report is organized along topical lines in parallel to a Program Plan of the same title (to be published) so that activities and accomplishments may be followed readily relative to that Program Plan. Thus, the work of a given laboratory may appear throughout the report. Chapters 1 and 2 report topics which are generic to all of the DAFS Program: DAFS Task Group Activities and Irradiation Test Facilities, respectively. Chapters 3, 4, and 5 report the work that is specific to each of the subtasks around which the program is structured: A) Environmental Characterization, B) Damage Production, and C) Damage Microstructure Evolution and Mechanical Behavior.

53976 (HEDL-SA—1619) **Effect of pulsed HVEM irradiation on microstructure evolution in a simple Fe-Ni-Cr alloy.** Powell, R.W.; Odette, G.R. (Westinghouse Hanford Co., Richland, WA (USA); California Univ., Santa Barbara (USA)). 1979. Contract EY-76-C-14-2170. 6p. (CONF-790125—79). P 02/MF A01.

From 1. topical meeting on fusion reactor materials; Miami Beach, FL, USA (29 Jan 1979).

The effect of pulsed electron irradiation on microstructure evolution was studied in a simple Fe-Ni-Cr alloy and the results compared with a theoretical model. Pulse periods of 2.5 to 60 seconds (duty factor near 50%) at 600°C significantly reduced the maximum swelling rate compared to continuous irradiation. The void concentration was observed to increase and void size and swelling rates to decrease for the pulsed cases compared to the steady irradiation. Preliminary model calculations were used to guide the experiments and in the qualitative interpretation of the results. While there are several areas of agreement with experiment, the results indicate that further development of the models is required.

53977 (LA-UR—79-2053) **Overview of CTR-division control and data acquisition usage at the Los Alamos Scientific Laboratory.** Chandler, G.I.; Klare, K.A.; Lillberg, J.W.; Wilkins, R.W. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 15p. (CONF-791005—3). P 02/MF A01.

From ISA national conference; Chicago, IL, USA (22 Oct 1979).

Computers have become an integral part of the control and data acquisition systems of several different fusion experiments in the CTR Division. These systems must (1) monitor and/or control approximately 200 to 1000 signals, (2) process from 40 to 250 diagnostic channels with a maximum plasma discharge repetition rate of once every five minutes, and (3) operate in an electrically noisy environment. Small to medium scale minicomputers interfaced to the experiment through CAMAC modules have been used to meet these requirements. System shielding and grounding have been given special consideration. These systems are also used for on-line data analysis and are linked to the local CTR network User Service Center where additional off-line analysis can be performed.

53978 (ORNL/CSD/TM—92) **Feedback control modeling of plasma position and current during intense heating in ISX-B.** Charlton, L.A.; Swain, D.W.; Neilson, G.H. (Oak Ridge National Lab., TN (USA)). Aug 1979. Contract W-7405-ENG-26. 41p. P 03/MF A01.

The ISX-B Tokamak at ORNL is designed to have 1.8 MW (and eventually 3 MW) of neutral beam power injected to heat the plasma. This power may raise the anti β of the plasma to over 5% in less than 50 msec if the plasma is MHD stable. The results of a numerical simulation of the feedback control system and poloidal coil power supplies necessary to control the resulting noncircular (D-shaped or elliptical) plasma are presented. The resulting feedback control system is shown to be straightforward, although nonlinear voltage-current dependence is assumed in the power supplies. The required power supplied to the poloidal coils in order to contain the plasma under the high heating rates is estimated.

53979 (ORNL/TM—6361) **Calculated irradiation response of materials using fission reactor (HFIR, ORR, and EBR-II) neutron spectra.** Gabriel, T.A.; Bishop, B.L.; Wiffen, F.W. (Oak Ridge National Lab., TN (USA)). Aug 1979. Contract W-7405-ENG-26. 31p. P 03/MF A01.

In order to plan radiation damage experiments in fission reactors keyed toward fusion reactor applications, it is necessary to have available for these facilities displacement per atom (dpa) and gas production rates for many potential materials. This report supplies such data for the elemental constituents of alloys of interest to the United States fusion reactor alloy development program. The calculations are presented for positions of interest in the HFIR, ORR, and EBR-II reactors. DPA and gas production rates in alloys of interest can be synthesized from these results.

53980 (ORNL/TM—6904) **Dose rates from induced activity in the TFTR test cell.** Alsmiller, R.G. Jr.; Barish, J.; Santoro, R.T.; Lillie, R.A.; Barnes, J.M.; Ragheb, M.M.H. (Oak Ridge National Lab., TN (USA)). Aug 1979. Contract W-7405-ENG-26. 29p. P 03/MF A01.

Calculated dose rates in the TFTR test cell from induced activity have been obtained. The dose rates for the case of no neutral beam injector and when a neutral beam injector (with the resultant large penetration through the primary shield) is present are given separately. The photon transport calculations are carried out using Monte Carlo techniques since this greatly facilitates the consideration of different pulse sequences and times after reactor shutdown. Dose rates are given for several different D-T pulse sequences and for a variety of times after the reactor is turned off. At a few positions in the test cell the contribution to the dose rates from individual residual nuclei are also presented. In general, it is found that the presence of the shielded neutral beam injector does not have a large effect on the dose rates in the test cell.

53981 (SAND—79-0656C) **Flux and energy of deuterium incident on a limiter-like probe in PLT.** McCracken, G.M.; Cohen, S.A.; Dylla, H.F.; Rossnagel, S.M.; Magee, C.W.; Picraux, S.T.; Wampler, W.R. (UKAEA, Abingdon. Culham Lab.; Princeton Univ., NJ (USA). Plasma Physics Lab.; RCA Labs., Princeton, NJ (USA); Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 10p. (CONF-790912—1). P 02/MF A01.

From 9. European conference on controlled fusion and plasma physics; Oxford, UK (17 Sep 1979).

The radial dependence of the flux and energy of deuterium incident on a probe in PLT has been determined from analysis of deuterium retained in the probe. From this data and the assumption of a poloidal symmetry it is concluded that deuterium ion impacts on the limiters can account for an impurity generation rate via sputtering of .5 - 3 x 10^{19} s^{-1} and a power flow onto the limiters of 11 to 18% of the ohmic heating.

53982 (SAND—79-1310C) **Depth distributions of low energy deuterium implanted into silicon as determined by SIMS.** Magee, C.W.; Cohen, S.A.; Voss, D.E.; Brice, D.K. (Princeton Univ., NJ (USA); Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 14p. (CONF-790671—3). P 02/MF A01.

From 4. international conference on ion beam analysis; Aarhus, Denmark (25 Jun 1979).

Secondary ion mass spectrometry (SIMS) has been used to determine depth profiles of deuterium implanted into single crystal silicon targets at energies between 0.1 and 5 keV. The atomic mixing inherent in the sputtering process, which directly effects depth resolution, has been reduced by using a bombarding particle of low energy and high Z impacting the sample at a large angle relative to the surface normal (3 keV, Cs^+, impacting at 60°). Using this procedure, depth resolution of 20 A at a depth of 800 A has been obtained in depth profiling of Ta_2O_5 on Ta. Mean projected range and straggling of the implant profiles are in good agreement with calculations when irradiations are performed at 11° from the normal to the (100) plane. Irradiation at normal incidence results in substantially larger ranges. The saturation density of trapped deuterium has also been determined to be 1.4 x 10^{22} D/cm^3.

53983 (SAND—79-1368c) **Ion implantation applied to fusion research.** Vook, F.L.; Doyle, B.L.; Picraux, S.T. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 32p. (CONF-790753—1). P 03/MF A01.

From 2. US-USSR seminar on ion implantation; Moscow, USSR (8 Jul 1979).

Ion implantation and microanalysis have been used to investigate plasma-surface interactions relevant to fusion applications. Previous results for pure metals are reviewed and current results are presented for TiB_2 and B_4C coatings for tokamak surfaces. Enhanced trapping of implanted, low-energy hydrogen has been shown to occur at room temperature in W, Au, Pd, Mo, Nb, TiB_2, and B_4C for He or other ion predamage. Hydrogen depth profiles obtained using $^1H(^{19}F, \alpha\gamma)^{16}O$ resonant nuclear reaction show that the H decorates the He damage profiles at traps whose concentration is proportional to the amount of He-induced damage.

53984 (UCRL—15083) **Cryogen system analysis for the Mirror Fusion Test Facility. Final report.** Parmley, R.T.; Hausman, R.F.; Naes, L.G. (Lockheed Missiles and Space Co., Palo Alto, CA (USA). Lockheed Palo Alto Research Lab.). Jun 1979. Contract W-7405-ENG-48. 59p. (LMSC-D—673326). P 04/MF A01.

The Mirror Fusion Test Facility being designed and constructed at the Lawrence Livermore Laboratory requires a liquid helium liquefaction, storage, distribution, and recovery system and a liquid nitrogen storage and distribution system. To provide a powerful analytical tool to aid in the design evolution of this system through hardware, a thermodynamic fluid flow model was developed. This final report defines the cryogen system that was analyzed (consisting of the LHe subsystem, the GHe recovery subsystem and the LN_2 subsystem). It details the program assumptions, the theoretical basis for the analysis and limitations of the output. Several parametric runs were performed to illustrate the use of the program. Special detailed analyses were also performed on components such as the recuperator in the helium gas recovery system.

GENERAL AND MISCELLANEOUS

MANAGEMENT

REFER ALSO TO CITATION(S) 53272, 53641, 53642, 53643, 53644, 53645, 53646, 53647, 53653, 53656

53985 (BNL—50972) **Abstracts: Energy Sciences programs, January—December 1978.** (Brookhaven National Lab., Upton, NY (USA)). May 1979. Contract EY-76-C-02-0016. 164p. P 08/MF A01.

This report presents abstracts of all publications in the Energy Sciences programs of the Department of Energy and Environment from January 1, 1978 through December 31, 1978. It is a companion report to Annual Highlights of Programs in Energy Sciences - (December 1978, BNL 50973). Together, they present scientific and/or technical highlights of the Energy Sciences programs for the past calendar year, detailed descriptions of all the programs, and the publication issuing from the work performed. The following are some of the topics included: porphyrin chemistry; chemistry of energetic compounds; combustion; coal utilization; metal hydrides; cyclic separations process research; trace element analysis; materials properties and structures; radiation damage; superconducting materials; materials of construction for geothermal applications; repair of deteriorated concrete; development of glass—polymer composite sewer pipe; flash hydropyrolysis of coal; desulfurization of high-temperature combustion and fuel gases; and synthetic fuels development. (RWR)

53986 (TID—3376) **Summaries of energy research at colleges and universities.** (Department of Energy, Oak Ridge, TN (USA). Technical Information Center). Jun 1979. 478p. P 19/MF A01.

Many of the basic studies conducted in support of the Department of Energy's management of the nation's energy supplies are conducted by college and university faculty members and students. These studies cover a broad spectrum ranging from the physical sciences and engineering through the social, economic, and political sciences. This publication acknowledges and records this significant contribution. Records of 1531 studies at 225 colleges and universities are included. Each record is introduced by the name of the project, the name of the individual heading the study group, and the name of the college or university. A paragraph that describes each study activity and in some cases publications that have resulted from the study are included. Investigator, research organization, location of research, and subject indexes are provided. The following subjects are included: coal and coal products; petroleum; natural gas; oil shales and tar sands; nuclear fuels; fusion fuels; isotope and radiation source technology; hydrogen; other synthetic and natural fuels; hydro energy; solar energy; geothermal energy; wind energy; electric power engineering; nuclear power plants; nuclear reactor technology; energy storage; energy management and policy; energy conversion; energy conservation, consumption, and utilization; advanced automotive propulsion systems; materials; chemistry; engineering; explosions and explosives; environmental sciences, atmospheric; environmental sciences, terrestrial; environmental sciences, aquatic; environmental—social aspects of energy technologies; biomedical sciences, basic studies, biomedical sciences, applied studies, health and safety; geosciences; physics research; fusion energy, general and miscellaneous.

MATHEMATICS AND COMPUTERS

REFER ALSO TO CITATION(S) 53466, 53708, 53714, 54008

53987 (ANL—79-53) **Equivalence between resolvent consistency and convergence for nonlinear quasi-contractive algorithms.** Reich, S. (Argonne National Lab., IL (USA)). Jun 1979. Contract W-31-109-ENG-38. 18p. P 02/MF A01.

Let E be a reflexive Banach space with a uniformly Gateaux differentiable norm; D, a closed convex subset of E; and C, a nonexpansive retract of D. Let F(t): D → C, 0 ≦ t < ∞, be a continuous family of mappings with F(0) = I on C, such that abs. value [F(t)x-F(t)y] ≦ [M(t)][abs. value (x-y)] for x and y in D and t ≧ 0 with M(t) = 1 + ωt + o(t) as t → 0+ for some ω ≧ 0. If lim/sub n → infinity/ F(t/n)/sup n/x = S(t)x exists for each x in C uniformly on compact t intervals, then lim/sub t → 0+/(I + (λt)(I-Ft)))$^{-1}$x = J/sub λ/x exists for each x in D and 0 < λ < 1/ω.

53988 (ANL—79-75) **Iterative solution of linear programs.** Mangasarian, O.L. (Argonne National Lab., IL (USA)). Jul 1979. Contract W-31-109-ENG-38. 26p. P 03/MF A01.

By perturbing a linear program to a quadratic program, it is possible to solve the latter in its dual variable space by iterative techniques such as successive over-relaxation (SOR) methods. This solution provides a solution to the original linear program. 2 tables.

53989 (BNL—50967) **Permanent file guide.** Clifford, T.S. (Brookhaven National Lab., Upton, NY (USA)). May 1979. Contract EY-76-C-02-0016. 37p. P 03/MF A01.

This volume documents the use and management of the file systems associated with the mainframes at the BNL Central Scientific Computing Facility. The basic tools for storing, using, and discarding files are documented as well as being described in terms of job control statements, but the user should be aware that there are FORTRAN subroutines and COMPASS macros to perform the same functions provided by the control statements. (RWR)

53990 (CONF-7906102—1) **Regularity of solutions to an inhomogeneous differential equation in Banach space.** Travis, C.C. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 14p. P 02/MF A01.

From Functional differential and integral equations conference; Morgantown, WV, USA (18 Jun 1979).

Let T(t), t > or = 0, be a strongly continuous semigroup of bounded linear operators in the Banach space X with infinitesimal generator, and let f be a continuous X-valued function on (0, infinity). It is well known that, without some restrictions on the semigroup T(t), t > or = 0, or the continuous function f, the weak solution v(t) = T(t)x + ∫$_0$/sup t/ T(t-s)f(s)ds [eq. A], need not be a strong solution of the inhomogeneous linear differential equation du(t)/dt = Au(t) + f(t), u(0) = x [eq. B]. The purpose of this work is to characterize the class of strongly continuous semigroups for which a weak solution of eq. B is a strong solution when f is an element of C([o,r];X). It is shown that eq. A is a strong solution of eq. B for every continuous function f iff the semigroup T(t), t > or = 0, is of bounded semivariation. (RWR)

53991 (LA—7916-MS) **Summation of imprecise numbers.** Metropolis, N. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 8p. P 02/MF A01.

An algorithm is presented for computer summation of imprecise numbers that may have quite disparate magnitudes and variances. Each number is represented by its expected value and variance. Exact numbers form a subset and are treated in a consistent manner. Cancellation effects are minimized.

53992 (LA—7933-MS) **Network Simulator of LASL's Common File System.** Harlow, M.V. Jr. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 35p. P 03/MF A01.

The Network Simulator is a software system that emulates a network of worker computers that communicate with the Production Program of the Los alamos Scientific Laboratory's Common File System. The simulator generates protocol messages and test data sets and sends these to and receives them from the Production Program. Both the simulator and the Production Program reside in separate partitions of an IBM 370/148 computer. This report describes the simulator's design, operation, and user inputs. 8 figures, 8 tables.

53993 (LA—7957-MS) **LASL benchmark performance 1978.** McKnight, A.L. (Los Alamos Scientific Lab., NM (USA)). Aug 1979. Contract W-7405-ENG-36. 8p. P 02/MF A01.

This report presents the results of running several benchmark programs on a CDC STAR-100, a Cray Research CRAY-1, a CDC 6600, a CDC 7600, and a CDC Cyber 73. The benchmark effort included CRAY-1's at several installations running different operating systems and compilers. This benchmark is part of an ongoing program at Los Alamos Scientific Laboratory to collect performance data and monitor the development trend of supercomputers. 3 tables.

53994 (ORO—3443-82) **Reliable error estimation and mesh adaptation for the finite element method.** Babuska, I.; Rheinboldt, W.C. (Maryland Univ., College Park (USA). Inst. for Physical Science and Technology). Apr 1979. Contract EY-76-S-05-3443. 70p. (BN—910). P 04/MF A01.

Recent work in computational structural analysis and design has been greatly aided by the evolution of the finite element method into a powerful tool for the solution of a broad range of problems. This report addresses the following questions: how to calculate, at reasonable cost, reliable estimates of the error of computed finite element solutions; how to set up the overall solution process so as to achieve, with reasonable certainty and efficiency, a solution for which the accuracy either falls into a prescribed range or is best possible for the allotted computational cost. Certain one- and two-dimensional problems are considered first; later, the results are extended to nonlinear problems. Experimental results for a particular nonlinear two-point boundary-value problem show that the combination of continuation, error estimation, and adaptive mesh construction should be an extremely effective approach to the computational solution of many practical engineering problems. 15 figures, 11 tables. (RWR)

53995 (PNL—3066) **Data acquisition system for light-ion irradiation creep experiment.** Hendrick, P.L.; Whitaker, T.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jul 1979. Contract EY-76-C-06-1830. 97p. P 05/MF A01.

Software was developed for a PDP11V/03-based data acquisition system to support the Light-Ion Irradiation Creep Experiment installed at the University of Washington Tandem Van de Graaff Accelerator. The software consists of a real-time data acquisition and storage program, DAC04, written in assembly language. This program provides for the acquisition of up to 30 chennels at 100 Hz,

data averaging before storage on disk, alarming, data table display, and automatic disk switching. All analog data are acquired via an analog-to-digital converter subsystem having a resolution of 14 bits, a maximum throughput of 20 kHz, and an overall system accuracy of +-0.01%. These specifications are considered essential for the long-term measurement of irradiation creep strains and temperatures during the light-ion bombardment of irradiation creep specimens. The software package developed also contains a collection of FORTRAN programs designed to monitor a test while in progress. These programs use the foreground/background feature of the RT-11 operating system. The background programs provide a variety of services. The program, GRAFTR, allows transient data (i.e., prior to averaging) to be graphed at the graphics terminal. The program, GRAFAV, allows averaged data to be read from disk and displayed graphically at the terminal. The program, TYPAV, reads averaged data from disk and displays it at the terminal in tabular form. Other programs allow text messages to be written to disk, read from disk, and allow access to DAC04 initialization data. 5 figures, 18 tables.

53996 (SAND—79-1302) **Word processing with RUNOFF on VAX-11/780: a primer.** Yates, A.L. (Sandia Labs., Albuquerque, NM (USA)). Aug 1979. Contract EY-76-C-04-0789. 42p. P 03/MF A01.

This document describes the use of RUNOFF, a program which facilitates preparation of documents. Also discussed is the use of an HP 264/4/5/8 terminal, on which the rough draft of a document may be typed to be input to the VAX. 2 figures, 3 tables.

53997 (SAND—79-8243) **Numerical rank determination in linear least squares problems.** Manteuffel, T.A. (Sandia Labs., Livermore, CA (USA)). Aug 1979. Contract EY-76-C-04-0789. 52p. P 04/MF A01.

The linear least-squares problem A x congruent to b has a unique solution only if the matrix A has full column rank. Numerical rank determination is difficult, especially in the presence of uncertainties in the elements of A. This report proposes an interval analysis approach. A set of matrices A/sup I/ that contains all possible perturbations of A due to uncertainties is defined, and that A/sup I/ is called rank deficient if any member of A/sup I/ is rank deficient. A modification to the Q-R decomposition method of solution of the least-squares problem allows a determination of the rank of A/sup I/. The additional computational effort is $O(N^3)$, where N is the column dimension of A. 2 figures.

53998 (SU-SEL—79-012) **Theory of interpretive architectures: some notes on DEL design and a FORTRAN case study. Technical report No. 171.** Hoevel, L.W.; Flynn, M.J. (Stanford Univ., CA (USA). Computer Systems Lab.). Feb 1979. Contract EY-76-S-03-0326-039. 66p. (SU—326-P.39-32). P 04/MF A01.

An interpretive architecture is a program representation that peculiarly suits a particular high-level language or class of languages. The architecture is a program representation called a directly executed language (DEL). This paper attempts to develop a reasonably comprehensive theory of DEL synthesis. By assuming a flexible interpretation-oriented host machine, synthesis involves three particular areas: sequencing (both between image machine instructions and within the host interpreter) action rules (including both format for transformation and operation invoked), and finally, the name space which includes both name structure and name environment. A complete implementation of a simple version of FORTRAN is described in the appendix of the paper. This DEL for FORTRAN, called DELtran, comes close to achieving the ideal program measures. 10 figures, 5 tables.

53999 (UCID—18234) **Correcting the plotting symbol positioning error in Tektronix's GRAPH PLOT 50 software (4050A07 series B).** Owen, L.B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Aug 1979. Contract W-7405-ENG-48. 11p. P 02/MF A01.

The Graph Plot 50 (GP-50) software is an extremely useful package for rapid preparation of graphs. However, the current version of the software has a coding error which results in a serious misalignment of plotting symbols with respect to the actual position of data points in a user-defined x-y coordinate system. When graphs are produced using the series 4050 CRT Screen, one plotting symbol (+) is properly located, but most other characters are offset along the x- and/or y-axis. When graphs are produced using the Model 4662 digital plotter, all plotting symbols are misaligned on the y-axis. A simple modification to GP-50 was devised for eliminating the symbol positioning error. The eight most frequently used plotting symbols (X,x,O,o,*,+,0, and .) are automatically compensated to insure proper positioning when output is created on either the series 4050 screen display or the 4662 plotter. Other keyboard characters can be used as plotting symbols, if desired, but automatic positioning compensation is not provided. 7 figures.

54000 (UCID—18247) **User's guide to the DCON deconvolution code.** Feit, M.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). May 1979. Contract W-7405-ENG-48. 21p. P 02/MF A01.

DCON is a 7600 code that uses Fourier transform techniques to solve the convolution equation S(t) = R(t)*I(t), where the * stands for the integral convolution operator. S is the output signal, R, the response function, and I, the input signal. For example, I might be the input to some linear physical system whose impulse response is R. Then S(t) will be the output of the system. The basic purpose of the code is to find I(t), given S(t) and R(t). One may also actually know the input and output signals and wish to find the impulse response. Because real data are always noisy, and deconvolution tends to greatly amplify noise, considerable attention was given to various filtering schemes and ways of limiting the bandwidth over which the deconvolution takes place. This feature makes the code practical, and allows one to quantify exactly what (in terms of smoothing, bandwidth, etc.) has been done to the measured data to allow deconvolution. The various filtering options are explained. The various switches to the user allow the code to be used to convolve two functions, filter a function, or just obtain its spectral representation. Output can be obtained in the form of graphs and SOCKITTOME files. (RWR)

54001 (UCID—18257) **Linear weighted least-squares estimation.** Doerr, T.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Aug 1979. Contract W-7405-ENG-48. 54p. P 04/MF A01.

The linear weighted least-squares estimator is developed and compared to the minimum variance estimate. A sequential form of the estimator is also constructed and compared to the Kalman filter estimator. The sequential least-squares estimate is implemented within an existing Kalman filtering code called DYNEST. Numerical examples are provided for the comparison of the estimators. 23 figures, 5 tables.

54002 (UCID—30175) **Array processing for FORTRAN.** Wetherell, C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 27 Aug 1979. Contract W-7405-ENG-48. 77p. P 05/MF A01.

The charge to a special task force on Cray FORTRAN (STF) included the consideration of ...new language features to exploit the vector hardware of the CRAY-1 that might also be applicable to other large scientific computers. This document is a reference manual for a family of array processing features which extend FORTRAN (specifically LRLTRAN) so that the CRAY-1 can be so exploited. The new array processing features provide access to the computing power of vector machines in a way which is easy for the programer to write, easy for others to read, and easy for compilers to process. The features are designed to be machine independent with efficient implementations available. 18 figures, 3 tables. (RWR)

54003 (UCRL—15074) **Algebraic modeling system.** Miller, A.C. (Applied Decision Analysis, Inc., Menlo Park, CA (USA)). Jul 1979. Contract W-7405-ENG-48. 13p. P 02/MF A01.

This report summarizes the design of an algebraic modeling system. The first section discusses the purpose and capabilities of the algebraic modeling system. The second section specifies the set of commands used to instruct the system to construct and analyze models.

54004 (UCRL—50025-79-2, pp 15-17) **Computer graphics made easier with a microprocessor.** 30 Jun 1979.

In Electronics Engineering Department quarterly report No. 2, 1979.

An all-digital cursor system with eight selectable cursor patterns and enhanced x-y coordinate input options is readily available for the LLL television monitor display system (TMDS). The system easily and accurately pinpoints a specific piece of data on the TMDS screen. 4 figures.

54005 (UCRL—81994) **Computer graphics for large scale two- and three-dimensional analysis of complex geometries.** Brown, B.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). May 1979. Contract W-7405-ENG-48. 11p. P 02/MF A01.

A comprehensive set of programs was developed for analysis of complex two- and three-dimensional geometries at the University of California's Lawrence Livermore Laboratory. State-of-the-art finite element and hydrodynamic codes are being used for the analytical portion of the work. To assist the analytical effort, several additional codes which depend heavily on graphics were developed. These are basically used for the pre- and post-processing of the data. Prior to running any analysis, the geometry of the body of interest must be represented in the form of small finite elements. After the analysis is run, the data must be post-processed. Both spatial and temporal data exist in the database. It is the database between the analysis codes and the post-processors which allows a wide variety of analysis codes to use the same post-processors. The temporal plotting codes produce time histories for specified quantities (i.e. temperature, pressure, velocity, stress, etc.) at various locations within the body. They may also produce cross-plots of these variables (i.e. stress vs strain at a particular position). For plotting of the spatial data two codes are used. The first is for two-dimensional

geometries, and the second, for three-dimensional models. For three dimensions, the Watkins' hidden surface/line processor is utilized for plots. The spatial plotters display contour lines on vector output devices and color fringes (or gray values) on raster output devices. They both may also display deformed geometries. Further, the three-dimensional code has extensive animation capabilities for movie productions. These graphics codes are used with a wide variety of analyses codes and form a very comprehensive package for the engineering analysis of two- and three-dimensional bodies. 29 figures.

INFORMATION HANDLING

54006 (DOE/TIC—4579-R10(Suppl.5)) **Energy information data base. Serial titles, February 1978—June 1979.** (Department of Energy, Oak Ridge, TN (USA). Technical Information Center). Jun 1979. 115p. P 06/MF A01.

This supplement contains changes and additions to TID-4579-R10 (the authority list for serial titles used by TIC), and is intended to be used with that publication. Supplements are cumulative until another revision is issued. (RWR)

54007 (DOE/TIC—4585-R1(Suppl.2)) **Energy information data base. Corporate author entries, June 1978—June 1979.** (Department of Energy, Oak Ridge, TN (USA). Technical Information Center). Jun 1979. 43p. P 03/MF A01.

This supplement contains additions to TID-4585-R1 (the authority list for corporate author names used by TIC), and is intended for use with that publication. Supplements are cumulative from June 1978 until another revision is issued.

54008 (SAND—79-1417C) **Expression of general relationships (networks) in System 2000 data bases.** Hall, R.C.; Jones, R.D.; Richard, B.D. (Sandia Labs., Albuquerque, NM (USA)). Jul 1979. Contract EY-76-C-04-0789. 8p. (CONF-790914—1). P 02/MF A01.

From Astute fall conference; Washington, DC, USA (24 Sep 1979).

An enhancement to the System 2000 data base management system is proposed. This enhancement will allow the expression of general relationships among entities (data sets) in a System 2000 data base. These relationships are to exist in addition to the System 2000 hierarchical tree structure, and will permit System 2000 users to define networks of entities associated by the general relationships. The general relationships are to be expressible in the form of entity attributes, just as existing attributes (repeating groups and elements) are expressible for the entities. 1 figure.

CIVILIAN DEFENSE

54009 (ORNL—5352) **Maintaining nutritional adequacy during a prolonged food crisis.** Franz, K.B.; Kearny, C.H. (Oak Ridge National Lab., TN (USA)). Aug 1979. Contract W-7405-ENG-26. 113p. P 06/MF A01.

This handbook is the first to assemble nutritional information and make recommendations on the efficient use of unprocessed grains, beans, and other elemental foods during the aftermath of a nuclear war. These basic foods would constitute the main resources to combat famine after a major nuclear attack. Such an attack would reduce and probably eliminate most commercial food processing for many months. To decision .nakers, this handbook should prove useful on basic aspects of nutrition in a long-term survival situation. These decision makers might range from the heads of families to government officials. Recommendations for nutrition given by organizations experienced in crisis feeding are reviewed and compared. Based on the best nutritional information available, emergency dietary recommendations are made for minimum and intermediate goals. The emergency dietary recommendations are applied to food for practical survival rations. Long-term survival rations for Americans are evaluated. These rations are (1) ten single-food rations; (2) four cereal-legume rations, ratio 4:1; (3) four cereal-legume rations, ratio 8:1; and (4) four cereal-legume-dry milk rations. The 22 different survival rations are detailed and summarized in 20 tables which list their nutritional adequacies and deficiences. Expedient procedures are given by which basic foods may be processed and cooked to provide a more healthful diet than most Americans believe possible. Special attention is given to the requirements of infants, children, and pregnant or lactating women. The eleven appendixes provide a wealth of specialized information. Among these appendixes is one that summarizes new and improved expedient methods for removing radioactive fallout and other contaminants from water. Another appendix is a comprehensive account of ways to sprout seeds to produce vitamins and improve palatability. (ERB)

CORPORATE INDEX

In the Corporate Index, report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

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The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processses applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept. (e.g. Pipeline Quality Gas see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed.

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77(7523-24)-1	4:52809	*See* SAN-1101/PA2-16
78(7694-04)-2	4:52785	*See* SAN-1101/PA8-9
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910	4:53994	*See* ORO-3443-82
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CONF-750950-	(Conference on technical applications of superconductivity, Alushta, USSR, 16-19 Sep 1975)	
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CONF-7603129-	(Workshop on the evolving structure of the electric utility industry, McLean, VA, USA, 9-10 Mar 1978)	
	4:53347	*See* MTR-7193
CONF-7703126-	(Symposium on investigations in the field of reprocessing of irradiated fuel, Carlsbad, Czechoslovakia, 28 Mar-1 Apr 1977)	
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CONF-7705167-	(Conference on coal cleaning - an option for increased coal utilization, Arlington, VA, USA, 24-25 May 1977)	
	4:52426	*See* EPA-600/7-77-130
CONF-7709192-	(10. aerosol technology meeting, Albuquerque, NM, USA, 26-28 Sep 1977)	
1	4:53649	*See* BNWL-SA-6447
CONF-771114-	(5. ecological symposia on energy and environmental stress in aquatic systems, Augusta, GA, USA, 2-4 Nov 1977)	
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	4:52986	*See* SERI/TP-31-061
	4:52987	*See* SERI/TP-31-061
	4:52988	*See* SERI/TP-31-061
	4:52989	*See* SERI/TP-31-061
	4:52990	*See* SERI/TP-31-061
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CONF-771261-	(Conference on coal gasification and hydrogenation, Essen, F.R. Germany, 7-8 Dec 1977)	
10	4:53133	*See* AED-CONF-77-565-007
CONF-771277-	(Symposium of mechanical engineering energetic, Beograd, Yugoslavia, 1 Dec 1977)	
	4:53207	Belgrade, Yugoslavia; Masinski Fakultet Univerziteta u Belgrade (1977).
CONF-780114-	(International Solar Energy Congress, New Delhi, India, 16-21 Jan 1978)	

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CONF-7803101-		(Conference on carbonaceous particles in the atmosphere, Berkeley, CA, USA, 20-22 Mar 1978)
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CONF-780440-		(American power conference, Chicago, IL, USA, Apr 1978)
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CONF-7804121-		(International solar energy conference and fair, El Paso, TX, USA, 13-16 Apr 1978)
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1	4:53563	*See* SLAC-PUB-2274
CONF-780663-		(SERI concentrator symposium, Denver, CO, USA, 13-15 Jun 1978)
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CONF-7806150-		(Tercera mesa redonda de palenque, Pebble Beach, CA, USA, 11-17 Jun 1978)
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CONF-780779-		(Minicomputer and computations in chemistry workshop, Berkeley, CA, USA, 19-21 Jul 1978)
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CONF-780811-		(7. conference on plasma physics and control, Innsbruck, Austria, 23-31 Aug 1978)
37	4:53892	*See* RL-78-095
CONF-780833-		(Conference on few body systems and nuclear forces, Graz, Austria, 24-30 Aug 1978)
7	4:53811	*See* ORO-5223-12
CONF-780850-		(Workshop to identify research needs on the formation of acid precipitation, Alta, UT, USA, 22-25 Aug 1978)
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CONF-7808105-		(4. annual conference of the Solar Energy Society of Canada, Inc., London, Canada, 20-24 Aug 1978)
P1	4:52916	SESCI 1978 Conference, P.O. Box 2220, Station A, London, Ontario, Canada
P2	4:52940	SESCI 1978 Conference, P.O. Box 2220, Station A, London, Ontario, Canada
CONF-7809122-		(2. building physics congress on the occasion of the ISO/glass technical fair, Duesseldorf, F.R. Germany, 28 Sep-1 Oct 1978)
1	4:53384	*See* AED-Conf-78-270-003
CONF-7809162-		(Workshop on coal liquefaction, Julich, F.R. Germany, 18-19 Sep 1978)
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CONF-781142-		(Chemical hydrogen energy systems contracts review, Washington, DC, USA, 28-30 Nov 1978)
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CONF-781150-		(Symposium on assessing the industrial hygiene monitoring needs for the coal conversion and oil shale industries, Upton, NY, USA, 5-7 Nov 1978)
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CONF-781241-		(Conference on high-level radioactive solid waste, Denver, CO, USA, 19-21 Dec 1978)
	4:52683	*See* NUREG/CP-0005
CONF-790111-		(International symposium on thermodynamics of nuclear materials, Julich, F.R. Germany, 29 Jan-2 Feb 1979)
7(Trans)	4:53495	*See* ANL-Trans-1175
CONF-790117-		(3. US/USSR symposium on fusion - fission hybrids, Princeton, NJ, USA, 22-26 Jan 1979)
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CONF-790125-		(1. topical meeting on fusion reactor materials, Miami Beach, FL, USA, 29-31 Jan 1979)
77	4:53969	Dep. NTIS, PC A02/MF A01
79	4:53976	*See* HEDL-SA-1619
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CONF-790140-		(International workshop on gross properties of nuclei and nuclear excitations VII, Hirschegg, Kleinwalsertal, Austria, 15-20 Jan 1979)
5	4:53825	*See* LBL-9009
CONF-790156-		(2. topical conference on atomic processes in high temperature plasmas, Boulder, CO, USA, 17-19 Jan 1979)
1	4:53768	*See* UCRL-81957
CONF-790219-		(AIME annual meeting, New Orleans, LA, USA, 18-21 Feb 1979)
11	4:53094	*See* BNL-25957
CONF-790304-		(19. annual ASME symposium, geological disposal of nuclear waste, Albuquerque, NM, USA, 15-16 Mar 1979)
7	4:52701	*See* UCRL-82284
CONF-790327-		(IEEE particle accelerator conference, San Francisco, CA, USA, 12-14 Mar 1979)
107	4:53567	*See* SLAC-PUB-2272
110	4:53561	*See* LBL-8899
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CONF-790365-		(16. rencontre de moriond, Les Arcs, Savoie, France, 17-23 Mar 1979)
7	4:53801	*See* COO-3071-240
CONF-790415-		(177. national meeting of the American Chemical Society, Honolulu, HI, USA, 1-6 Apr 1979)
P2	4:52500	24: No. 1, 110-120(1979)
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P4	4:53468	Washington, DC; American Chemical Society (1979).
CONF-790423-		(2. multiphase flow and heat transfer symposium workshop, Miami Beach, FL, USA, 16-18 Apr 1979)
15	4:53215	Dep. NTIS, PC A02/MF A01
CONF-790440-		(12. oil shale symposium, Golden, CO, USA, 18-20 Apr 1979)
5	4:52604	*See* UCRL-82077

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CONF-790441-		(ANS topical meeting on light water reactor fuel performance, Portland, OR, USA, 29 Apr-2 May 1979)
8	4:53159	Dep. NTIS, PC A02/MF A01
CONF-790446-		(4. annual heat pump technology conference, Stillwater, OK, USA, 9-10 Apr 1979)
5	4:52898	Dep. NTIS, PC A02/MF A01
CONF-790459-		(Instrument Society of America, Pittsburgh modeling and simulation conference, Pittsburgh, PA, USA, 25-27 Apr 1979)
3	4:52947	*See* SERI/TP-34-236
CONF-790484-		(American Physical Society meeting, Washington, DC, USA, 23 Apr 1979)
2	4:53804	*See* COO-3071-241
CONF-790493-		(Electric Power Research Institute cogeneration workshop, San Antonio, TX, USA, 1-4 Apr 1979)
2	4:53136	*See* DOE/NASA/1062-79/1
CONF-790497-		(27. annual meeting of the southeastern section of the Geological Society of America, Blacksburg, VA, USA, 26-27 Apr 1979)
1	4:53697	*See* DP-MS-78-94
CONF-790499-		(American Society of Civil Engineers Power Research Council/Electric Power Research Institute workshop, San Diego, CA, USA, 23-25 Apr 1979)
2	4:53410	Dep. NTIS, PC A02/MF A01
CONF-790512-		(14. world gas conference, Toronto, Canada, 27 May-1 Jun 1979)
3	4:53325	Chicago, IL; Institute of Gas Technology (1979).
CONF-790524-		(6. international congress symposium on radiation research and stem cells, Tokyo, Japan, 13-19 May 1979)
11	4:53858	Dep. NTIS, PC A02/MF A01
CONF-790529-		(Conference on Optics, Los Alamos, NM, USA, 23-25 May 1979)
7	4:53960	*See* LA-UR-79-1960
8	4:53962	*See* LA-UR-79 2058
10	4:53961	*See* LA-UR-79-2057
CONF-790538-		(Fast ion transport in solids-electrode and electrolytes conference, Lake Geneva, WI, USA, 21-25 May 1979)
15	4:53462	*See* COO-1198-1264
CONF-790540-		(2. international conference on megagauss magnetic field generation and related topics, Washington, DC, USA, 29 May-1 Jun 1979)
12	4:53875	*See* SAND-78-2446C
CONF-790541-		(International Solar Energy Society meeting, Atlanta, GA, USA, 28 May 1979)
14	4:53008	*See* SERI/TP-35-277
28	4:52962	*See* LA-UR-79-1650
33	4:52974	*See* SAND-78-2046C
41	4:52874	Dep. NTIS, PC A02/MF A01
42	4:52972	*See* LBL-9317
43	4:52772	*See* COO-4094-46
49	4:52806	*See* COO-4878-6
51	4:52807	*See* COO-4878-7
52	4:52967	*See* COO-2577-18
CONF-790552-		(US-Japan joint seminar on plasma spectroscopy, Kyoto, Japan, 7-11 May 1979)
1	4:53894	Dep. NTIS, PC A02/MF A01
CONF-790572-		(Helium Breeder Associates/US Dept of Energy GCFR technical meeting, San Diego, CA, USA, 30 May-1 Jun 1979)
3	4:53173	Dep. NTIS, PC A02/MF A01
5	4:53185	*See* GA-A-15512
CONF-790585-		(DOE workshop on plasma wall interactions, Germantown, MD, USA, 31 May-1 Jun 1979)
1	4:53890	Dep. NTIS, PC A02/MF A01
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CONF-790594-		(11. national conference on radiation control, Oklahoma City, OK, USA, 6-10 May 1979)
1	4:53725	Dep. NTIS, PC A02/MF A01
CONF-790596-		(2. WISAP task workshop - Waste isolation safety assessment program, Seattle, WA, USA, 24-25 May 1979)
1	4:52671	*See* BNL-26333
CONF-790597-		(International symposium on ceramics in nuclear waste management, Cincinnati, OH, USA, 2 May 1979)
1	4:52668	*See* RFP-2915
CONF-7905105-		(Conference on using land to save energy, Chicago, IL, USA, 18-19 May 1979)
3	4:53396	Dep. NTIS, PC A02/MF A01
CONF-790602-		(ANS annual meeting, Atlanta, GA, USA, 3-8 Jun 1979)
82(Summ.)	4:53189	*See* HEDL-SA-1756-5
83	4:53219	*See* HEDL-SA-1754-FP
CONF-790610-		(International conference on nuclear physics with electromagnetic interactions, Mainz, F.R. Germany, 5-9 Jun 1979)
5	4:53838	Dep. NTIS, PC A02/MF A01
CONF-790615-		(3. US national congress on pressure vessels and piping, San Francisco, CA, USA, 25-29 Jun 1979)
21	4:53165	*See* BNL-NUREG-25947
22	4:53220	*See* HEDL-SA-1773
23	4:53221	*See* HEDL-SA-1794
24	4:53218	*See* HEDL-SA-1641
CONF-790622-		(Pulsed power conference, Lubbock, TX, USA, 12-14 Jun 1979)
19	4:53952	*See* SAND-79-1246C
26	4:53545	Dep. NTIS, PC A02/MF A01
CONF-790625-		(14. carbon conference, University Park, PA, USA, 25-29 Jun 1979)
7	4:53465	*See* COO-2712-7
CONF-790631-		(6. OTEC conference, Washington, DC, USA, 19-22 Jun 1979)
10	4:52882	Dep. NTIS, PC A02/MF A01
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CONF-790634-		(72. annual Air Pollution Control Association meeting, Cincinnati, OH, USA, 24-28 Jun 1979)
2	4:53148	Dep. NTIS, PC A02/MF A01
CONF-790638-		(3. annual biomass energy systems conference, Golden, CO, USA, 5-7 Jun 1979)
1	4:52730	*See* LBL-9188
3	4:52731	*See* LBL-9189
4	4:52796	Dep. NTIS, PC A02/MF A01
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CONF-790640-		(18. symposium on engineering aspects of magnetohydrodynamics, Butte, MT, USA, 18-20 Jun 1979)
3	4:53372	Dep. NTIS, PC A02/MF A01
4	4:53366	Dep. NTIS, PC A02/MF A01
CONF-790641-		(Rare earth research conference, Fargo, ND, USA, 25-28 Jun 1979)
7	4:53442	Dep. NTIS, PC A02/MF A01
8	4:53483	Dep. NTIS, PC A02/MF A01
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5	4:53802	*See* BNL-26483
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11	4:53868	*See* LA-UR-79-1878
13	4:53443	Dep. NTIS, PC A02/MF A01
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4	4:53450	Dep. NTIS, PC A02/MF A01
6	4:53970	Dep. NTIS, PC A02/MF A01
CONF-790658-		(27. annual conference on mass spectrometry and allied topics, Seattle, WA, USA, 3-8 Jun 1979)
1	4:53497	Dep. NTIS, PC A02/MF A01
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5	4:53856	*See* LBL-9173
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2	4:53117	Dep. NTIS, PC A02/MF A01
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3	4:53982	*See* SAND-79-1310C
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2	4:53291	Dep. NTIS, PC A02/MF A01
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4	4:53385	Dep. NTIS, PC A02/MF A01
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3	4:52911	*See* SERI/TP-34-187

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2	4:53773	*See* LA-UR-79-1913
CONF-790698-		(Society of Women Engineers national student conference, San Francisco, CA, USA, 27 Jun 1979)
1	4:53878	*See* UCRL-82768
CONF-7906101-		(7. Canadian seminar on surfaces, Pinawa, Manitoba, Canada, 10-13 Jun 1979)
1	4:53968	*See* UCRL-82980
CONF-7906102-		(Functional differential and integral equations conference, Morgantown, WV, USA, 18-10 Jun 1979)
1	4:53990	Dep. NTIS, PC A02/MF A01
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2	4:53441	*See* BNL-25949
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1	4:53934	*See* LBL-9465
CONF-7906108-		(Workshop on artificial aerosols, Vail, CO, USA, 19-20 Jun 1979)
1	4:52749	*See* SERI-TP-36-309
CONF-7906109-		(Conference on focus on the T-Matrix approach, Columbus, OH, USA, 25-27 Jun 1979)
1	4:53859	*See* LA-UR-79-1954
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1	4:53861	*See* SLAC-PUB-2346
CONF-7906111-		(Solar cycle and dynamics mission conference, Wellesley, MA, USA, 14-19 Jun 1979)
1	4:53769	*See* LA-UR-79-1921
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2	4:53406	Dep. NTIS, PC A02/MF A01
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5	4:53864	*See* SAND-79-1148C
CONF-790707-		(20. annual meeting of the Institute of Nuclear Materials Management, Albuquerque, NM, USA, 16-19 Jul 1979)
11	4:52635	Dep. NTIS, PC A03/MF A01
19	4:53568	*See* LA-UR-79-1857
24	4:52714	*See* LA-UR-79-1821
25	4:52639	*See* LA-UR-79-1842
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28	4:52715	*See* LA-UR-79-1843
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12	4:53457	*See* UCRL-83020
14	4:53459	*See* SAND-79-0592C
15	4:53782	*See* COO-1198-1270
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3	4:53444	*See* COO-1198-1265
CONF-790739-		(Harvard computer graphics week '79, Cambridge, MA, USA, 15-20 Jul 1979)
3	4:52562	*See* LA-UR-79-1817
CONF-790741-		(DOE impact fusion workshop, Los Alamos, NM, USA, 10-13 Jul 1979)
3	4:53959	*See* LA-UR-79-1833
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1	4:53833	*See* LBL-9405
3	4:53857	*See* LBL-9494
4	4:53803	*See* BNL-26547
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1	4:53557	*See* BNL-26412
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1	4:52516	*See* LA-UR-79-1834
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1	4:53853	*See* LBL-9130
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1	4:53983	*See* SAND-79-1368c
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1	4:53767	*See* LA-UR-79-2045
2	4:53766	*See* LA-UR-79-2044
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1	4:52721	*See* UCRL-82755
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1	4:53439	*See* IS-M-195
2	4:53866	*See* COO-1198-1253
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2	4:53572	Dep. NTIS, PC A04/MF A01
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1	4:53434	*See* SAND-79-1032C
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1	4:52945	*See* LA-UR-79-2025
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1	4:53812	*See* LA-UR-79-2046

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2	4:53806	Dep. NTIS, PC A03/MF A01
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19	4:53088	*See* LA-UR-79-1908
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1	4:53528	*See* SAND-79-1322C
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1	4:53981	*See* SAND-79-0656C
3	4:53948	*See* COO-5069-12
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5	4:52544	*See* SAND-79-0593C
6	4:52609	*See* UCRL-82455
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1	4:54008	*See* SAND-79-1417C
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1	4:52576	*See* UCRL-82441
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1	4:53527	*See* SAND-79-0984C
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1	4:53869	*See* SAND-79-1055C
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1	4:52648	*See* SAND-78-2447C
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3	4:53977	*See* LA-UR-79-2053
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2	4:53261	*See* BNL-26452
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2	4:52483	*See* SAND-79-1226C
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2	4:52586	Dep. NTIS, PC A03/MF A01
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79-14546	4:52781	NTIS PCA06/MF A01
79-14548	4:52782	NTIS PCA04/MF A01
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79160	4:53136	*See* DOE/NASA/1062-79/1
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23245	4:53061	TIC
23251	4:53078	TIC
23551	4:53283	Dep. NTIS (US Sales Only), PC A99/MF A01
23808	4:53213	California Energy Resources Conservation and Development Commission, 1111 Howe Ave., Sacramento, CA
23825	4:53072	Dep. NTIS (US Sales Only), PC A04/MF A01
23826	4:53067	Dep. NTIS, PC A06/MF A01
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79/0039	4:53421	NTIS PCN01/MF N01
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129	4:53156	Paper copy available on subscription, North American Continent price, $120.00/year; single copy price PC, $12.50; all others write for quote.
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79-1	4:53652	Eastern Environmental Radiation Facility, P.O. Box 3009, Montgomery, AL
79-2	4:53477	Eastern Environmental Radiation Facility, P.O. Box 3009, Montgomery, AL
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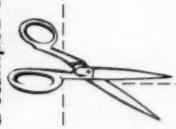

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